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CIVIL ENGINEERING.

On Boilers and Boiler Explosions. By W. Fairbairn, Esq., F. R. S.*

Various notions are entertained as to the causes of boiler explosions, and scientific men are not always agreed as to whether they arise from excessive pressure due to the accumulation of heat, or to some other cause, such as the explosion of hydrogen gas, generated by the decomposition of water suddenly thrown on heated plates, of which we have an exceedingly indefinite conception. That of the decomposition of water is, I believe, a somewhat prevalent opinion, but I apprehend it cannot be the invariable cause, inasmuch as in that case we must assume the boiler to be nearly empty of water, and the plates over the furnace red hot.

It is not unreasonable to suppose, that a force of such sudden origin, and so immediate and destructive in its effects, should suggest the presence of an explosive mixture; but I think it will be difficult, if not impossible, to account for the accumulation of a sufficient quantity of hydrogen without the presence of oxygen and other gases, in their due proportions, to form an explosive compound. Now, as these equivalents cannot be generated all at once by the simple decomposition of water (admitting for the moment that the water is decomposed), we must look for some other cause for the fatal and destructive accidents which, of late years, have been so prevalent.

In treating of this subject, I hope to show not only what are the probable causes of explosion, but what appears equally important, what are

* From the London Practical Mechanic's Journal, June, 1853.

not the causes. So many theories (some of them exceedingly problematical) have been brought forward on the occasion of disastrous explosions, that it requires the utmost care and attention to circumstances before they are generally admitted. To acquire satisfactory evidence as to the precise condition of the boiler and furnaces before an explosion is next to impossible, as most frequently the parties in charge, and from whose mismanagement and neglect we may, in many cases, date the origin of the occurrence, are the first to become the victims of their own indiscretion, and we can only judge from the havoc and devastation that ensues as to the immediate cause of the event.

From this it follows that, in many of the explosions on record, few, if any, of the real circumstances of the case are made known, and we are left to draw conclusions from the appearance of the ruptured parts, and the terrific consequences which too frequently follow as a result. This want of evidence as to the precise condition of a boiler, with all its valves and mountings, preceding an explosion, is much to be regretted, as it causes a degree of mystery to surround the whole transaction; and the vague and sometimes inaccurate testimony of witnesses, but too often baffles all attempts at research, and creates additional cause of alarm to all those exposed to the occurrence of similar dangers.

In the discussion of this subject, I shall, however, endeavor to trace, from a number of examples in which I have been personally engaged, and from others which have come to my knowledge, the causes which have led to the disastrous effects.

In my attempts to ascertain facts by a course of reasoning which I shall have to follow in this investigation, I could wish it to be understood that it is not my intention to raise doubts and fears in the public mind, calculated to arrest the progress of commercial enterprise, or to cripple the energies of mechanical skill. On the contrary, I am most anxious to promote the advancement of the useful arts, to increase our confidence in the application of increased pressure, and to secure, within moderate bounds, the economical and useful employment of one of the most powerful agents ever known in the history of practical science. My object in this inquiry will, therefore, be to enlarge our sphere of action by a more comprehensive knowledge of the subject on which it treats; to induce greater caution along with improved construction; and to insure confidence in all those requirements essential to the public security.

For the attainment of these objects, it will be necessary to divide the subject into the following heads:—

1*st*, Boiler explosions arising from accumulated internal pressure;
2*d*, Explosions from deficiency of water;
3*d*, Explosions produced from collapse;
4*th*, Explosions from defective construction;
5*th*, Explosions arising from mismanagement or ignorance; and,
6*th*, The remedies applicable for the prevention of these accidents.

1*st*, *Boiler explosions arising from accumulated internal pressure.*—In nine cases out of ten, a continuous increasing pressure of steam, without the means of escape, is probably the immediate cause of explosion: in some instances it arises from deficiency of water, but accidents of this kind are comparatively few in number, as we often find in tracing the

causes, that they have their origin in undue pressure, emanating from progressive accumulation of steam of great force and intensity. Let us take an example—to some of which I am able to refer—and we shall find that a boiler, under the influences of a furnace in active combustion (as the recipient of heat), will generate an immense quantity of steam, and unless this is carried off by the safety-valve, or the usual channels, when generated, the greatest danger may be apprehended by the continuous increase of pressure that is taking place within the boiler. Suppose that, from some cause, the steam thus accumulated does not escape with the same rapidity with which it is generated; that the safety-valves are either inadequate to the full discharge of the surplus steam, or that they are entirely inoperative, which is sometimes the case, and we have at once the clue to the injurious consequences, which, as a matter of fact, are sure to follow. The event may be procrastinated, and repeated trials of the antagonist forces from within, and the resistance of the plates from without, may occur without any apparent danger; but these experiments, often repeated, will at length injure the resisting powers of the material, and the ultimatum will be the arrival of the fatal moment, when the balance of the two forces is destroyed, and explosion ensues. How very often do we find this to be the true cause of accidents arising from extreme internal pressure, and how very easily these accidents might be avoided by the attachment of proper safety-valves to allow the steam to escape, and relieve the boiler of those severe trials which ultimately lead to destruction! If a boiler, whose generative power be equal to 100, be worked at a pressure of 10 lbs. on the square inch, the area of the safety-valves should also be equal to 100, in order to prevent a continuous increase of pressure; or in case of the adhesion of any of the valves, it is desirable that their areas should, collectively, be equal to 100. If two or more valves are used, 100 or 120 would then be the measure of outlet. Under these precautions, and a boiler so constructed, the risk of accident is greatly diminished; and provided one of the valves is kept in working order, beyond the reach of interference by the engineer, *or any other person*, we may venture to assume that the means of escape are at hand, irrespective of the temporary stoppage of the usual channels for carrying off the steam.

So many accidents have occurred from this cause—the defective state of the safety-valves—that I must request attention whilst I enumerate a few of the most prominent cases that have come before me. In the year 1845, a tremendous explosion took place at a cotton-mill in Bolton. The boilers, three in number, were situated under the mill, and from unequal capacity in the safety-valves, and even those imperfect, as they were probably fast, a terrific explosion of the weakest boiler took place, which tore up the plates along the bottom, and the steam having no outlet at the top, not only burst out the end next the furnace, demolishing the building in that direction, but tearing up the top on the opposite side, the boiler was projected upwards in an oblique direction, carrying the floors, walls, and every other obstruction before it; ultimately it lodged itself across the railway at some distance from the building. Looking at the disastrous consequences of this accident, and the number of persons—from sixteen to eighteen—who lost their lives on the occasion, it became a subject of deep

interest to the community that a close investigation should immediately be instituted, and a recommendation followed, that every precaution should be used in the construction as well as the management of boilers.

The next fatal occurrence on record in this district was a boiler at Ashton-under-Lyne, which exploded under similar circumstances, namely, from excessive interior pressure, when four or five lives were lost; and again, at Hyde, where a similar accident occurred from the same cause, which was afterwards traced to the insane act of the stoker or engineer, who prevented all means for the steam to escape by tying down the safety-valve.

There was a boiler exploded at Malaga, in Spain, some years since, and my reason for noticing it in this place is to show, that explosions may be apprehended from other causes than those enumerated in the divisions of this inquiry, and that is *incrustation*. Dr. Ritterbrandt says in a paper read before the Institution of Civil Engineers, by an eminent chemist, Mr. West, "that a sudden evolution of steam, under circumstances of incrustation, is no uncommon occurrence." In several instances I have known this to be the case, particularly in marine boilers, where the incrustation from salt water becomes a serious grievance, either as regards the duration of the boiler, or the economy of fuel.

If it were supposed, as Dr. Ritterbrandt observes, that the boiler was incrusted to the extent of half an inch, it would at once be seen that nothing was more easy than to heat the boiler strongly, even to a red heat, without the immediate contact of water. Under these circumstances, the hardened deposits being firmly attached to the plates, and forming an imperfect conductor of heat, would greatly increase the temperature of the iron; and the great difference of temperature thus induced between the material, and the greater expansibility of the iron, would cause the incrustation to separate from the plates, and the water rushing in between them would generate a considerable charge of highly elastic steam, and thus endanger the security of the boiler.

These phenomena were singularly exemplified in the Malaga explosion, which is thus described by Mr. Hick:—"I have ascertained that a very thick incrustation of salt was found on the lower part of the boiler, immediately over the fire, and, so far as it extended, the plates appear to have been red hot, thereby much weakened, and hence the explosion. The ordinary working pressure of the boiler is 130 lbs. per square inch, and perhaps at the time of the explosion very much above that pressure, as there was only one small safety-valve of two and a half inches diameter. The boiler was only two feet six inches diameter, and twenty feet long."

Incrustation, exclusive of being dangerous, is attended with great expense and injury to the boiler by its removal. In the case of Translantic, Oriental, or other long sea-going vessels—even after the use of brine-pumps, blowing out, &c.—a very large amount of incrustation is formed, and considerable sums of money are expended each voyage to remove it.

Other explosions, of a more recent date, are those which occurred at Bradford and Halifax. They are still fresh in the recollection of the public mind, and are so well known as not to require notice in this place.

I cannot, however, leave this part of the subject without reverting to

an accident which occurred on the Lancashire and Yorkshire Railway, which had its origin in the same cause—excessive internal pressure. This accident is the more peculiar, as it led to a long mathematical disquisition as to the nature of the forces which produced results at once curious and interesting. The conclusions which I arrived at, although *practically right, were, however, considered by some mathematically wrong*, as they were firmly combated by several eminent mathematicians; and notwithstanding the number of algebraic formulas, and the learned discussions of my friends on that occasion, I have been unable to change the opinions I then formed to others more conclusive.

The accident here alluded to occurred to the "Irk" locomotive engine, which in February, 1845, blew up, and killed the driver, stoker, and another person who was standing near the spot at the time. A great difference of opinion as to the cause of this accident was prevalent in the minds of those who witnessed the explosion, some attributing it to a crack in the copper fire-box, and others to the weakness of the stays over the top; neither of these opinions were, however, correct, as it was afterwards demonstrated that the material was not only entirely free from cracks and flaws, but the stays were proved sufficient to resist a pressure of 150 to 200 lbs. on the square inch. The true cause was afterwards ascertained to arise from the fastening down of the safety-valve of the engine (an active fire being in operation under the boiler at the time), which was under the shed, with the steam up, ready to start with the early morning train.

The effect of this was the forcing down of the top of the copper fire-box upon the blazing embers of the furnace, which, acting upon the principle of the rocket, elevated the boiler and engine, of 20 tons weight, to a height of 30 feet, which, in its ascent, made a somerset in the air, passed through the roof of the shed, and ultimately landed at a distance of 60 yards from its original position. The question which excited most interest, was the absolute force required to fracture the fire-box, its peculiar properties when once liberated, and the elastic or continuous powers in operation, which forced the engine from its place to an elevation of 30 feet from the position on which it stood. An elaborate mathematical discussion ensued, relative to the nature of these forces, which ended in the opinion that a pressure sufficient to rupture the fire-box, was, by its continuous action, sufficient to elevate the boiler, and produce the results which followed. Another reason was assigned, namely, that an accumulated force of elastic vapor at a high temperature, with no outlet through the valves, having suddenly burst upon the glowing embers of the furnace, would charge the products of combustion with their equivalents of oxygen, and hence explosion followed. Whether one or both of these two causes were in operation is probably difficult to determine; at all events, we have in many instances precisely the same results produced from similar causes, and unless greater precaution is used in the prevention of excessive pressure, we may naturally expect a repetition of the same fatal results.

The preventives against accidents of this kind are well-constructed boilers of the strongest form, and duly proportioned safety-valves, one under the immediate control of the engineer, and the other, as a reserve, under the keeping of some competent authority.

2d. Explosions from deficiency of water.

This division of the subject requires the utmost care and attention, as the circumstance of boilers being short of water is no unusual occurrence. Imminent danger frequently arises from this cause, and it cannot be too forcibly impressed upon the minds of engineers, that there is no part of the apparatus which constitutes the mountings of a boiler which require greater attention—probably the safety-valves not excepted—than that which supplies it with water. A well-constructed pump and self-acting feeders—when boilers are worked at a low pressure—are indispensable; and where the latter cannot be applied, the glass tubular gauge steam and water cocks must have more than ordinary attention.

In a properly constructed boiler, every part of the metal exposed to the direct action of the fire should be in immediate contact with the water, and when proper provision is made to maintain the water at a uniform height and depth above the plates, accidents can never occur from this cause.

Should the water, however, get low from defects in the pump, or any stoppage of the regulating feed-valves, and the plates over the furnace become red hot, we then risk the bursting of the boiler, even at the ordinary working pressure. We have no occasion, under such circumstances, to search for another cause, from the fact that the material when raised to a red heat has lost above five-sixths of its strength, and a force of less than one-sixth will be found amply sufficient to bear down the plates directly upon the fire, or to burst the boiler.

When a boiler becomes short of water, the first, and perhaps the most natural action is, to run to the feed-valve, and pull it wide open. This certainly remedies the deficiency, but increases the danger, by suddenly pouring upon the incandescent plates a large body of water, which, coming in contact with a reservoir of intense heat, is calculated to produce highly elastic steam. This has been hitherto controverted by several eminent chemists and philosophers; but I make no doubt such is the case, unless the pressure has forced the plates into a concave shape, which, for a time, would retard the evaporization of the water when suddenly thrown upon them. Some curious experimental facts have been elicted on this subject, and those of M. Boutigney and Professor Bowman, of King's College, London, show that a small quantity of water projected upon a hot plate does not touch it; that it forms itself into a globule, surrounded by a thin film, and rolls about upon the plate without the least appearance of evaporation. A repulsive action takes place, and these phenomena are explained upon the supposition that the spheroid has a perfectly reflecting surface, and consequently the heat of the incandescent plate is reflected back upon it. What is, however, the most extraordinary in these experiments is the fact, that the globule, whilst rolling upon a red-hot plate, never exceeds a temperature of about 204° of Fahrenheit; and, in order to produce ebullition, it is necessary to cool the plate until the water begins to boil, when it is rapidly dissipated in steam.

The experiments by the committee of the Franklin Institute on this subject, give some interesting and useful results. That committee found that the temperature of clean iron, at which it vaporized drops of water, was 334° Fahrenheit. The developement of a repulsive force, which I have endeavored to describe, was, however, so rapid above that temper-

ature, that drops which required but one second of time to disappear at the temperature of maximum vaporization, required 152 seconds when the metal was heated to 395° of Fahrenheit. The committee goes on to state that—"One ounce of water introdued into an iron bowl three-sixteenths of an inch thick, and supplied with heat by an oil-bath at the temperature of 546°, was vaporized in fifteen seconds, while at the initial temperature of 507°, that of the most rapid evaporization was thirteen seconds."

The cooling effect of the metal is here strikingly exemplified by the increased rapidity of the evaporization, which, at a reduced temperature of 38°, is effected in thirteen instead of fifteen seconds.

This does not, however, hold good in every case, as an increased quantity of water, say from one-eighth of an ounce to two ounces, thrown upon heated plates, raised the temperature of its vaporation from 460° to 600° Fahrenheit; thus clearly showing that the time required for the generation of explosive steam, under these circumstances, is attended with danger, and it may be doubted whether the ordinary safety-valves may not be wholly inadequate for its escape.

Numerous examples may be quoted to show that explosions from deficiency of water, although less frequent than those arising from undue pressure, are by no means uncommon; they are, nevertheless, comparatively fewer in number, and the preventives are good pumps, self-acting feeders (when they can be applied), and all those conveniences, such as water-cocks, water-gauges, floats, alarms, and other indicators of the loss and reduction of water in the boiler.

To be Continued.

For the Journal of the Franklin Institute.

Thicknesses of Arches. By Charles Ellet, Jr., Civ. Eng.

In some investigations on the equilibrium of arches, made many years ago, I deduced the following simple and convenient rule for determining the proper depth or thickness of the voussoirs of a cut stone arch at the crown.

I am not sure that I ever published the formula, though I have applied it in numerous works.

Let s represent the span of the arch, and T the thickness at the crown.

$$\text{Then } T = \frac{3}{8}\sqrt{s}.$$

or, *the depth of the voussoir at the crown, will be three-eighths the square root of the span.*

This simple rule is applicable to all arches, however great or however small the span, from a semi-circle, to the flatest segments ever attempted on public works. *It is always safe.*

I communicate the formula for the convenience of those who have no better rule to guide them.

Bath Alum, Va., June 28, 1853.

AMERICAN PATENTS.

List of American Patents which issued from June 14th, to July 12th, 1853, (*inclusive,*) *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

JUNE 14.

18. For an *Improvement in mode of Cutting Tenons;* Charles B. Fitch, Galena, Ill.

Claim.—"What I claim is, the method herein described of cutting tenons, by means of the scoring V shaped cutter, that cuts the square shoulder and point, and at the same time scores the side of the tenon, when this is combined with the lancet shaped, or other finishing cutter, for removing the material left by the scorers; the whole arranged and combined in the manner specified."

19. For an *Improvement in Harvesters of Grain and Grass;* William G. Huyett, Williamsburg, Pennsylvania.

Claim.—"I do not claim two series of movable knives or cutters, independent of the arrangement herein shown and described, for they have been previously used; but what I do claim as new is, the peculiar manner of arranging the two sets or series of knives, *b*, *c*, as herein shown and described, viz: the knives, *b*, being of triangular form, or saw shaped, and having a reciprocating motion, and the knives, *c*, working directly over the knives, *b*; said knives, *c*, being attached by pivots to the outer ends of the teeth, and having an opposite reciprocating motion, communicated to them at their inner ends, by the lever and cross bar, by which arrangement a drawing cut is obtained, and the knives effectually prevented from clogging and choking by the grass or straw."

20. For an *Improvement in Stoves;* S. S. Jewett and F. H. Root, Buffalo, New York, ante-dated December 14, 1852.

Claim.—"We do not claim the furnace or fire place of a stove or grate; nor merely making the door which closes the front thereof, to open and close by sliding, whether the same slides horizontally or vertically; nor making it slide on a ledge on the outside of the stove, nor into and out of the flues; but what we do claim is, the combination, in a stove or grate, of the fire place or furnace, with a sliding door or doors to close the front of the fire place, and a recess in one or both of the jambs of the fire place, for the door or doors to slide into, and be concealed from view on the outside, and be insulated from the fire and smoke within; this recess being a separate compartment, open only where the door enters, and only of sufficient capacity to receive the same, substantially in the manner and for the purposes herein set forth."

21. For an *Improvement in Mop Heads;* Harvey Murch, Lebanon, New Hampshire.

Claim.—"What I claim is, my improved mop head, composed of the fixed cross-head, which has grooves in its lower side and end, in combination with the sliding binder, that terminates in a notched shank and passes through the loop on the handle, which serves as a detent, in consequence of the action of the spring on the under side of the said shank, substantially as herein set forth."

22. For an *Improvement in the Manufacture of Metal Tubes;* George F. Muntz, Jr., Birmingham, England; patented in England, May 8, 1852.

"My invention consists of casting short tubes of a peculiar form or section, rolling them flat, to extend them in length, and then opening them out and rendering them cylindrical, as hereafter explained."

Claim.—"What I claim is, the mode or process of manufacturing a metallic tube, of Muntz's metal, or other like metal or composition of metals, viz: by first casting the metal in a short tube, of the form substantially as represented in figure 1; next heating it as described, and rolling it flat, essentially as exhibited in figure 2, and elongating it at the same time; and finally, opening it out and removing the surplus portions, or fins, and reducing it to its final form, in transverse section, as herein before specified."

23. For an *Improvement in Self Waiting Dining Tables;* Lea Pusey, Patterson, Pa.

Claim.—"What I claim is, a self waiting table, constructed and arranged substantially as described, viz: having an endless band, situated beneath the table and kept in constant

motion, during meals, (by any power, applied through the crank or other means,) to which band is firmly attached, at convenient distances apart, guiding carriers, which pass up through, and are supported by small railway trucks, and move in guiding apertures in the top of the table, and upon the tops of which are placed waiters, whereon dishes are put, and constantly conveyed around, before the guests, on both sides of the table, in combination with the said endless band conveyors. I also claim placing an additional shelf, or second table, over the central portion of the table, above the waiters, for the purpose of holding castors, &c., which do not require to be frequently removed or replaced, substantially as herein set forth."

24. For an *Improvement in Mortising Machines;* Fergus Purden, Baltimore, Md.

"The nature of my invention consists in making the bed piece in two parts, so that it may be adjusted to mortises, in different positions and of various widths, to allow the chips to escape from the under side of the piece mortised."

Claim.—"I do not claim a divided bed, such as has been used heretofore; but what I do claim is, a divided bed so constructed, that it can be adjusted to suit the widths of the mortise to be cut, so as to prevent the side of the mortise from being splintered by the cutter, or chips, when they are forced through, and driven out on the under side, substantially as described."

25. For an *Improvement in Brick Machines;* Alexander H. Sampson, New Orleans, Louisiana.

Claim.—"What I claim is, the box or reservoir of platforms, with the carrying chains, or their equivalents, provided with suitable projections, for catching, drawing forward, and carrying immediately underneath the delivery follower, the boards or platforms for receiving the pressed brick, and by which they are conveyed out of the machine, substantially as described."

26. For an *Improvement in Copying Presses;* E. H. Smith, City of New York.

Claim.—"What I claim is, 1st, The employment of the hand lever, to operate the pressing platen, through the agency or by means of the sliding transverse bar, or its equivalent, in combination with the adjustable stop, or any other mechanical device substantially the same. 2d, The arrangement of the plates, or platens, in such relation to their support and operating medium, as to render three of the four edges of each platen unobstructed perfectly available, and easy of access."

27. For an *Improvement in Type Casting Machines;* John J. Sturgis, City of N. York.

Claim.—"What I claim is, 1st, The use of the horizontal mould block rest, in combination with the vertical and horizontal rock shafts and cam, for the purpose of obtaining a motion of the mould block as nearly horizontal as practicable, substantially as set forth. 2d, The use of the lever and rod in combination with the horizontal mould block rest and matrix, substantially as set forth. 3d, The use of the matrix holder, having a slot in it, to allow of a lifting motion on its centre pin, and a notch in its back side, for the end of a spring to act against, in combination with the spring, inclined plane or cam, on the horizontal rock shaft and pin, for holding it, substantially as set forth. 4th, The V shaped bar secured to an adjustable end plate, attached to the outer end of the lower half of the mould block, in combination with the upper half of the mould block, for the purposes substantially as set forth."

28. For an *Improvement in Cooking Stoves;* Giles F. Filley, St. Louis, Missouri.

Claim.—"What I claim is, 1st, The flaring enlargement of the side flues, from the space above the oven to the flue space, which extends under the entire front end of the oven; and also the enlargement of the central flues F and G, from the said flue space to the upper end of G, for the purpose of increasing the draft of all the flues, and causing a larger portion of heat to be conducted into the said flue space, substantially as herein set forth. In combination with the flaring shape of the flues, F G, I also claim the auxiliary dumb flue, which rises from the flue space, to the hearth plate, and thence is continued immediately under the fire chamber, and up the back of the same, by which another portion of heat from the fire chamber is conducted, by radiation and circulation, into the said flue space, for the purpose of aiding in giving an increased draft to the stove, and in raising the temperature of the front end of the oven bottom to the required degree for baking purposes, substantially as herein set forth."

29. For an *Improvement in Manufacturing Glass;* James M. Brookfield and Ephraim V. White, Honesdale, Pennsylvania, (and Jacob Fatz, having been decided to be a joint inventor with said White,) the said Fatz and White, Assignors to Andrew A. Hay and James M. Brookfield.

"The nature of our invention consists in combining and using a blast, with the ordinary furnace, and anthracite coal as a fuel, for melting the materials in the manufacture of glass.

Claim.—"What we claim is, the application of a blast, and anthracite coal as a fuel, in the manufacture of glass, as herein set forth."

30. For an *Improvement in Moulding Gutta Percha Stereotype Plates;* John L. Kingsley, City of New York.

Claim.—"What I claim is, 1st, The process of expelling air from the surface of the type when forming the mould, and from the surface of the mould when forming the plate, substantially in the manner set forth, or in any equivalent way. 2d, The method described, or its equivalent, of dressing, leveling, or thicknessing the moulds or plates, when made of gutta percha, or compounds that run, so that all the plates made shall be invariably of the same thickness; all of which is herein fully described and set forth."

31. For an *Improvement in Manufacture of Plate Glass;* John J. Greenough, Boston, Massachusetts.

Claim.—"What I claim as my invention is, 1st, Manufacturing plates of glass, by causing the glass, while in a plastic state, to pass between two or more pairs of rollers, substantially in the manner and for the purpose set forth. I also claim embossing the surfaces of plate glass, by passing it between embossing rollers, as above described. And, lastly, I claim suspending plates of glass, by their upper edges, after they have been formed, while annealing, so as to keep them in a perfect plane, without resting on a bed."

JUNE 21.

32. For an *Improvement in Cut-off for Steam Engines;* Horatio Allen & D. G. Wells, City of New York.

Claim.—"What we claim is, the mode of operating the loose toes by means of sectors, combined with the rock shaft and operated in the manner substantially as herein described.

33. For an *Improvement in Piano Fortes;* Benjamin E. Colley, Cambridge, Mass.

Claim.—"I do not claim throwing off the fly from beneath the hammer arm by mechanism attached to or connected with the hammer arm itself, as that has been done before; but what I do claim is, throwing the fly of the jack from the arm which operates the hammer each time the note is struck, so as to prevent its "blocking" in the said arm, by the bent lever and set screw, operating independent of the hammer and hammer arm, in the manner set forth."

34. For an *Improvement in Power Printing Presses;* William H. Danforth, Salem, Massachusetts.

Claim.—"I do not wish to limit myself to the precise method of constructing and arranging the parts specified, as these may be varied at pleasure, so long as the principle or character of my invention is retained; what I do claim is, 1st, The employment in one printing press of two parallel type forms, one above the other, and two platens so arranged in a frame, as that a sheet of paper can be printed by each form, at one impression, substantially as above described. 2d, The mode of feeding the paper between the griping bars and bands, which hold it in place to receive the impression, and pass the sheet forward, while the inking roller occupies the intermediate space to ink the type. 3d, Making the feed bands unequal in thickness, as described, for the purpose of furnishing an opening between the two sets, at the time that the sheets are to be entered from the tympan. 4th, The employment of a series of griping or discharging cross bars, in combination with and so arranged upon two endless bands, as to be made to act upon the leading edges of the sheets as they pass along, and hold them against the feed bands, until they have passed across over the top of the pile upon the platform, substantially as shown, for the purpose of piling the printed sheets. 5th, The device for giving and checking the motion of the feed bands alternately as required, consisting of the vibrating lever, bar, reciprocating rack, connecting wheel, feeding wheel, fast wheel or disk, spring pawl, adjustable cam, stud or pin, studs, arm, rocking shaft, cams, pawls, brake, spring, and cylinder, arranged and operated substantially as shown."

35. For an *Improvement in Jacquard Apparatus of Looms;* John A. Elder, Westbrook, Maine.

"The main feature of my invention consists in placing one half of the trap boards directly above the other half, the position being such as to allow the knot-cords to pass from their point of suspension through holes in the two trap boards, thus placed one above the other, and a short distance apart."

Claim.—"What I claim is, 1st, The arrangement of two trap boards, placed the one above the other and between the suspension board and needles. 2d, Two trap boards arranged the one above the other, with their slots in opposite directions to the knot cord holes when combined with the knot cord, having a knot for each board, and a single set of needles for the purpose of vibrating the knot cords from the slots in one board to the slots in the other, the whole arranged and combined in the manner herein set forth."

36 For an *Improvement in Bog Cutting Cultivators;* Edward L. Freeman, Ann Arbor, Michigan.

Claim.—"What I claim is, the precise construction of the tooth, and placed in the position as set forth, that is to say, the vertical part and the horizontal, each having a backward slant."

37. For an *Improvement in Machines for Planing Metal;* Frederic W. Howe, Windsor, Vermont.

Claim.—"What I claim consists in combining with the endless chain and the primary tool carriage, the two slide boxes, (or their mechanical equivalents,) the binders, and rocker lever, and its operative mechanism, (viz: the rod, eccentric, shaft, and lever,) or the mechanical equivalents of such rocker lever, and operative mechanism, the whole being made to operate substantially in manner as described, and for the purpose of enabling a person to readily produce a movement of the tool carriage either to the right or left, while the endless chain has a continuous motion in one direction as set forth."

38. For an *Improvement in Cultivator Ploughs;* William S. Hyde, Townsend, Ohio.

Claim.—"What I claim is, the cultivator herein described, with adjustable supplementary wings, so constructed as to cultivate the soil superficially near the roots of the plants, and deeper at a distance therefrom, the wings being adjustable to any required angle with the bottom of the furrow, so as to give any desired degree of inclination to the sides of the ridges or hills, and to change their inclination from time to time, to adapt them to the varying stages of the growth of the plant, the whole being constructed and operating as described."

39. For an *Improvement in Feed Motion in Plug Cutting Machines;* Simon Ingersoll, City of New York.

Claim.—"What I claim is, the combination, substantially as described, of the slide bar L, having studs or projections, v, *r*, and the slide bar K, having studs or projections, *s*, *r*, the said studs or projections being all so arranged in relation to each other, that the devices which move both slide bars longitudinally, shall first give motion to the slide bar L, for the purpose of forcing the dogs into the board or piece preparatory to the feed, and relieve the dogs therefrom previous to their retrograde motion for commencing a new feed."

40. For an *Improvement in Cutters to Harvesters;* John H. Manny, Waddam's Grove, Illinois; patented in England, December 9, 1852.

Claim.—"What I claim is, a cutter or sickle, composed of a series of lozenge shaped blades attached to a bar, as herein set forth, whereby the pressure of the grass on the front corners of the blades is so counteracted that the latter are not bent down from the edges of the guard fingers, against which they cut."

41. For *an Improvement in Hill Side Ploughs;* David A. B. Newcomb, Conewango, New York.

Claim.—"What I claim is, arranging the two shafts of a double plough, which alternately run forward on a central wheel, in such a manner, that the share which for the time being is in the rear, shall be carried above the bottom of the furrow, substantially as described; also, the method of relieving the swivel, and of steadying and supporting the beam, when set and in turning, by means of a semicircular guide or track, arranged and operating in the manner and for the purposes herein set forth, in connexion with a catch at each end of the track to hold the beam in place when properly adjusted."

42. For an *Improvement in Electro-Magnetic Alarms;* Augustus R. Pope, Somerville, Massachusetts.

Claim.—"For the purpose of ringing the bell, I claim the combination of the movable or vibrating armature, and the spring circuit breaker, with the hammer of the bell, the same to be used in connexion with the electro-magnet circuit wires and a key (as described) applied to a door or window; the whole being made to operate together substantially in the manner and for the purpose as specified."

43. For an *Improvement in Seed Planters;* George Rohr, Charlestown, Virginia.

Claim.—"I claim the invention, use, and application of a ridged, or fluted, or corrugated vibrating apron device, combined with the oscillating screen, or grain scatterer, arranged with a crank handle, axis, actuated by the pins, or cogs, on the scollop-like hub flanch of the propelling wheel, together with the reacting spring rest. The whole arranged and used together with a seed fountain, with apertures so constructed as to admit of connecting thereto short detachable or movable mouth pieces, or outlet spouts, for the more perfect and free escape of the seed from the grain chamber or fountain, on to the apron and scatterer, specifically as set forth."

44. For an *Improvement in Lath Machines;* I. R. Shank, Buffalo, Virginia.

"The nature of my improvement consists in providing the machine with a gauge which is furnished with a vibratory motion, and answers the double purpose of regulating the thickness of the lath, and slipping it from the knife and table in order to be sure of its separation from the board, so as it can be shoved up at every stroke of the machine, and thereby cut a lath."

Claim.—"What I claim is, imparting a vibratory motion to the gauge bar, in the manner described, so that it will not only perform the function of gauge bar to regulate the thickness of the lath, but also that of a slipper, in order to insure the separation of the lath from the block for the purposes described."

45. For an *Improvement in Expanding Mandrels for Turning Machinery;* Walter Sherrod, Providence, Rhode Island.

"The nature of my invention consists in the use of an arbor having a taper turned thereon, on which is fitted an expanding cylindrical shell spring, cut open longitudinally with the arbor, and held in its place by the friction of its elasticity.

Claim.—"What I claim is, a divided spring shell, constructed in the manner described, when it is combined with a tapering mandrel, so that by its own elasticity it shall retain its position on said mandrel, the whole arranged, constructed, and combined in the manner herein set forth. Not meaning to claim the combination of a tapering mandrel with a shell divided into more than one piece and tapering on its interior surface, being held on said mandrel by a spring clasp."

46. For an *Improvement in Horse Collars;* William McK. Thornton, Bloomsburgh, Pennsylvania.

Claim.—"What I claim is, a horse collar formed with pad flaps by the extension of the face leather of the pads as described; also, the manner of stiffening and uniting the pads by means of a metallic bow, the ends of which are rigid to stiffen the shoulder pads and support the tugs, while its arch is flat, thin, and flexible, in one direction, to allow the pads to change their relative distance apart, comparatively rigid in the other direction, to prevent the pads from turning with respect to a plane parallel to the front of the collar."

47. For an *Improvement in Saws;* Joseph H. Tuttle, Seneca, New York.

Claim.—"What I claim is, the combination, arrangement, and location upon the same blade, of the setts of fleam teeth for scoring the sides of the kerf, and the setts of planing teeth for removing the wood between the scores, when said planing teeth are placed back to back; curve in opposite directions, and are between the setts of fleam cutters, and at sufficient distances apart, so that each planing tooth shall serve alternately as a gauge to its fellow, while allowing it to cut to a proper depth, and be a permanent guide to the fleam cutters, to prevent any of the teeth from taking too rank a hold upon the wood, which makes it run with great ease and efficiency, and is applicable to slitting or cross cutting, substantially as described."

48. For an *Improvement in Hill Side Ploughs;* Jonas B. Wilder, Belfast, Maine.

Claim.—"I do not claim a revolving share and mould board, attached permanently to each other; but what I claim is, having the mould board so constructed, arranged, and at-

tached to the share, and land side plate, that said mould board may be turned as set forth, independently of the share, and a proper curved outer face be presented to the sod, on either side of the plough, the mould board being constructed with two faces, precisely of the same form, as herein shown."

49. For an *Improvement in Metallic Pointed Pens;* Benjamin R. Norton, Syracuse, New York.

Claim.—"What I claim is, a metallic pointed pen attached to a wire of the length required to form a handle or holder, when such pen and holder are covered from the top of the holder to near the nib of the pen by a coating of gutta percha or india rubber, of suitable thickness, made in the manner and for the purpose set forth."

50. For an *Improvement in Propellers for Canal Navigation;* William F. Tyson, Orwigsburgh, Pennsylvania; ante-dated December 21, 1852.

Claim.—"What I claim is, the blades constructed with lips or rims, which are sections of a cylinder concentric with the axis on which the propeller rotates, as herein specified."

51. For an *Improvement in Side Lights for Ships;* Enoch Hidden, City of New York.

Claim.—"I do not claim ship lights turning on pivots or centre pins in frames; nor do I claim ship lights in frames turning on hinges; but what I do claim is, the arrangement of screws tapped into the main frame, in combination with inclined planes, or spirals forming part of said screws that holds the light frame, or cell containing the glass, fast to the india rubber in its grooved seat, in the main frame, with its stop pin for stopping the screw in its proper position, when the light is to be opened for ventilation; also, the projecting ears, with slots or chase mortises, in which the pivots of the light frame or cell turns, allowing the light to be hauled from its seat, and consequently out of contact with the india rubber, so as to allow the plane of the light to be placed at any angle to the main frame, thus freely admitting of ventilation. And further, I claim the arrangement of a lead or other ductile metallic ring, soldered on, or otherwise joined to the main brass frame of the light, so that it can be turned round the other edge of the opening in the vessel, securing any suitable material, completely, making the main frame of the light water tight to the vessel; the whole substantially as herein set forth in this specification and drawings, forming part of the same."

52. For *Improvements in Envelope Folding Machines;* R. L. Hawes, Worcester, Mass.

"The nature of my invention consists in providing in one self feeding machine, the ability, when motion is given it, to take one sheet of paper at one time, and carry it forward to impress or form a base, and thus to retain it until it is carried onward to the finisher, whence it is discharged, a finished or folded and pasted envelope. The paste being applied in its process, as will be hereinafter fully described."

Claim.—"What I claim is, 1st, The combination of the self adjusting feed table, with the paste fountains, so arranged as that they will descend, and press a freshly pasted surface of their rollers upon the top sheet, and raise it to permit the table to pass beneath and take away a sheet at every second revolution of the main shaft. 2d, The combination of the platform with the hooks, and the retaining fingers, and the fingers for discharging, for the purpose of properly conveying and discharging the sheet or envelope. 3d, The combination of the platform with the follower or first presser and its weight or retainer, as described. 4th, The finishing holder, consisting of knives, with their adjustable spring and guides, in combination with the finishing plunger, to press the envelope and cause the three flaps to adhere together or one to the other. 5th, The arrangement for raising the table, in combination with the fingers, for discharging the finished envelope; all of which is herein before fully described and set forth."

JUNE 28.

53. For an *Improvement in Refrigerators for Cooling Liquids;* Barnabas H. Bartol, Philadelphia, Pennsylvania; patented in Cuba, October 8, 1852.

Claim.—"I do not desire to claim the application of the current of air of a fan blower to cool water; but what I do claim is, the arrangement of the series of partitions and interstices, for cooling water, in the manner and for the purpose, substantially as herein set forth."

54. For an *Improvement in Bobbins;* Horatio Clarke, Dedham, Massachusetts.

Claim.—"I do not claim the making a bobbin head of two layers or disks of wood,

glued or cemented together; nor do I claim the invention of constructing one of raw hide entirely; but what I do claim is, the making the bobbin head as described, viz: of a combination of wood and raw hide, or other material having like properties, whereby the head is not only cheaply constructed, but rendered properly stiff, and capable of resisting the effects of blows, falls, or wear, as above stated."

55. For an *Improvement in Shuttle Box Motion in Looms;* Christopher Duckworth, Thompsonville, Connecticut.

"My improvement consists in the manner of operating the shuttle boxes, by means of the levers, friction rollers, notched sides, &c., so that the shuttle boxes may receive a lateral, vertical, and diagonal motion at pleasure; and may also be kept in any one position, as long as is required for any figure or character of the fabric, and be changed backward and forward, at pleasure, being governed by the card pattern."

Claim.—"What I claim is, the method of giving a three-fold movement (lateral, vertical, and diagonal,) to the shuttle boxes as described, by which I am able to operate any required shuttle at any given pick; I also claim the apparatus for operating the shuttle boxes, consisting of the case, with its friction rollers and slides combined with the levers, which work the slides, and the principal lever, which moves the shuttle boxes, when the whole is constructed, arranged, and combined substantially as herein described."

56. For an *Improvement in Melodeons;* Horatio N. Goodman, New Haven, Conn.

Claim.—"I am aware that two sets of keys have long been used in organs, and that two sets of reeds have been used in reed instruments; I therefore do not claim either of these, as such, as my invention; but what I claim is, the combination of the two sets of reeds with the two sets of keys, when these are combined with the two sets of valves, and so arranged, that each set of keys may play their own set of reeds independently, or so that the lower set of keys may play both sets of reeds, (in the ordinary way of two stops,) while the upper set of keys may play its own set of reeds only, in any other part of the key board, at the pleasure of the performer, when constructed and combined substantially as herein described; I also claim the within described method of coupling or connecting the lower set of keys, with the back set of valves, so that both sets of reeds may be played by the lower sets of keys, when the several parts are constructed, arranged, and used, in the manner and for the purposes substantially as herein described."

57. For an *Improvement in Machines for Twisting Waxed Ends;* Daniel H. Hovey, Kilborn, Ohio.

Claim.—"What I claim is, the combination of the revolving rollers or tubes, conical coupling cores, the spring tighteners with the detaching levers, arranged and operated substantially in the manner and for the purpose herein described."

58. For an *Improvement in Coating Zinc with Lead;* Edmund Morewood and George Rogers, London, England; patented in England, December 12, 1850.

Claim.—"We are aware that metals have been coated, one with another, by washing and plating, to protect them from oxydizing agents, &c., but we are not aware that zinc and lead have ever been united, and rolled into united laminæ of each of these metals, as above described. Therefore, we claim such a composite sheet as a new and useful manufacture, or article of merchandise or trade, of great value and importance, and which possesses the hardness, stiffness, and strength of zinc, with the capacity of lead, to resist the action of oxydizing agents, as herein set forth."

59. For an *Improvement in Bran Dusters;* Levi S. Reynolds, Indianapolis, Indiana.

Claim.—"What I claim is, the employment of the conical roughened metallic scourer in combination with the double disk rubber, the disks and pins of which always preserve the same relative positions; being arranged and operated in the manner and for the purpose set forth."

60. For an *Improvement in Percussion Pellets;* Christian Sharps, Hartford, Connecticut; patented in England, April 22, 1852.

Claim.—"What I claim is, the percussion pellet herein described, consisting of a quantity of detonating material, enclosed between two flanched disks, or shallow hollow cylinders, closed at one end; the open end of one cylinder being fitted into the open end of the other, and the two being firmly interlocked, by crimping together their flanches, rims, or peripheries, substantially as described, so as to form a pellet in the form of a disk."

61. For an *Improvement in Tuning Melodeons, and other Reed Instruments;* Edmund E. Shepardson and Edwin Lucas, New Bedford, Massachusetts.

Claim.—"We do not claim inserting reeds in pipes or tubes, for that has been previously done; but what we claim is, securing or attaching the reed to a movable pipe or tube, the reed being arranged or placed between stationary clamps, by which, as the pipe or tube is moved, the vibrating portion of the reed may be lengthened or shortened, and the desired tone obtained, as herein shown and described."

62. For an *Improvement in Machines for Turning Irregular Forms;* Lauren Ward, Administrator of Richard Ward, deceased, Naugatuc, Connecticut.

"The improvement consists in the use of the jointed levers, suspended from a bar or frame above the crank, by which the levers are operated, to elevate and depress the front end of the inner part of the carriage to the desired extent, for planing the article in an elliptic shape of polygon; and in the use of the notched collet on the front or toothed centre, connected with the ratchet wheel, which, by means of the curved bar, raises the front end of the inner part of the carriage still higher and more suddenly, than the operation of the levers would do, at the proper time, to give form to a more prominent part of the article, as the square part of a spoke."

Claim.—"What I claim is, the combination of the jointed levers, suspended by their upper ends with the crank and connecting rod, when so constructed and arranged as to elevate or depress the inner part of the carriage, and the toothed centre, in such a manner as to give a regular elliptical form to the polygon, where the opposite longitudinal sections will be equal and similar, when the whole is constructed, arranged, and combined, substantially as herein described. I also claim the use of the notched collet, on the toothed cutter, and the curved bar, in combination with the jointed levers, to give regular and irregular forms to different parts of the same elliptic polygon, when the whole is constructed and combined substantially as herein described."

63. For an *Improvement in Metallic Boxes for Presses, &c.;* James Foster, Jr., and Platt Evans, Jr., Cincinnati, Ohio.

Claim.—"What we claim is, the mode of preventing the shrinking and binding of metal bushings, when cast upon screws, mandrels, spindles, shafts, and the like, by the insertion of feathers, either movable or fixed in the boxes to be bushed, for the purpose of separating or breaking the ring of bushing metal, substantially in the manner and for the purpose herein set forth."

64. For an *Improvement in Presses;* Amzi C. Semple, Assignor to William C. Semple, Cincinnati, Ohio.

Claim.—"What I claim is, sustaining the gear frame of a double toggle press, by the toggle arms and joints, independent of and disconnected from the frame of the press, by attaching the same firmly to the nut, as described, in combination with supporting the screw by the nuts thus sustained only; the whole being arranged substantially as described."

65. For an *Improvement in Threshers and Separators of Grain;* Napoleon B. Lucas, Otter Creek, Illinois.

Claim.—"What I claim is, the auxiliary screen, placed in an auxiliary position, or nearly so, and projecting from the rear end of the inclined screen, so as to be out of the axis of the blast over the said screen, for the purpose of catching and saving the blighted and lighter kernels of grain, which may be blown beyond the rear extremity of the said inclined screen, substantially as herein set forth."

Re-issues for June, 1853.

1. For an *Improvement in Cooking Ranges;* Moses Pond, Boston, Massachusetts; patented February 25, 1851; re-issued June 7, 1853.

Claim.—"What I claim is, the improvements by which the hot water back is connected with the plate, *a*, and by means of which said hot water back may be either readily removed at any time, or applied in such manner that the directions of its water pipes may be disposed so as to accommodate the bath boiler, into which they are usually led, on whatever side of the range the bath boiler may be placed; the said improvements consisting, 1st, in the connecting piece, *n*, and the attachments of it, and the hot water back; the whole being made to operate together substantially in the manner as above set forth. 2d,

in a second set of attachments, (fixed on the opposite face of the water back,) in combination with the first set thereof, as described. I also claim the peculiar arrangement of flues, which lead the smoke and volatile products of combustion directly around the oven, the said arrangement of flues causing the heat to course against a portion or one-half of the bottom of the oven; next, into another flue, which takes it backwards, and against the other portion or half of the bottom of the oven; thence, up a flue against the oven; thence, through a flue, extending over and against a portion or half of the top of the oven; thence, into and through another flue, which carries it backwards and over and against the top of the oven, and conveys it to the chimney or discharge flue; not meaning to include in such arrangement the radiating chamber or space, y z, herein before mentioned. And I also claim the two recesses, *l m*, and two flue plates, *p q*, applied to the plate, K, in combination with the two valve openings, x x′, their damper and cover plate, as applied to the top plate of the oven frame, and used under an arrangement of oven flues, substantially as described, the same allowing of the adaptation of the oven to either side of the fire place, or the use of two such ovens and their frames, in connexion with the fire place, all essentially as herein before stated. I also claim the improvement by which the oven can be raised and readily removed, and by which the smoke is prevented from passing underneath the partition which separates the flues on top of the oven, the same consisting in the sliding or gravitating plate, *o′*, affixed to the partition, and made to operate substantially in the manner as specified."

2. For an *Improved Lubricating Compound;* Patrick S. Devlan, Reading, Pennsylvania; patented January 16, 1849; re-issued June 14, 1853.

"The nature of my invention consists in combining with animal or vegetable oil, or other fatty matter, such as concrete fats, a solution of caoutchouc or other similar gum, dissolved in turpentine or other solvent."

Claim.—"What I claim is, the combination of a solution of caoutchouc or other similar gum, with animal or vegetable oil or fatty matter, substantially as specified, applicable as a substitute for oil, in lubricating machinery, and for other purposes."

3. For an *Improvement in Apparatus for operating Shuttle Boxes of Looms;* James A. Bowie and Charles Carr, Assignees of Robert B. Goodyear, Philadelphia, Pennsylvania; patented March 13, 1849; ante-dated Sept. 13, 1848; re-issued June 14, 1853.

Claim.—"Having fully described the method of raising the shuttle boxes of power looms having two or more shuttles, what is claimed therein as the invention of the said Robert Burns Goodyear is, the employment, for the purpose of weaving, of an index plate, having movable and adjustable pins, projecting at different distances from the face of said plate, in combination with the shoe, or its equivalent, having projections corresponding to the different length of pins, for the purpose of raising and falling the shuttle boxes, to correspond with the pattern desired to be formed; the whole constructed and arranged in the manner herein described."

4. For an *Improvement in Machinery for making Mouldings;* Alfred T. Serrell, City of New York; patented May 16, 1848; re-issued Jan. 7, 1851; re-issued June 21, 1853

Claim.—"What I claim is, 1st, The combination of the ring or rings with a cutter or cutters, for operating on an angular strip for making a moulding, whether the said cutter or cutters be rotating or stationary, or both, and whether the said cutter or cutters operate on the face or on the edge of the strip, or on both the face and the edge, substantially as herein described. 2d, The combination of the adjustable bed with the ring or rings and a cutter or cutters, as aforesaid, for operating on an angular strip for making a moulding, whether the cutter or cutters be rotating or stationary, or both, and whether the said cutter or cutters operate on the face or on the edge of the strip, or on both the face and the edge, substantially as described."

5. For an *Improvement in Gas Regulators;* Walter Kidder, City of New York; patented October 12, 1852; re-issued June 28, 1853.

Claim.—"What I claim is, balancing the varying pressure of the gas in the main, by connecting with the valve a disk, which receives pressure from the main, to balance the pressure on the valve, substantially as described, or the equivalent therefor, in combination with the method, substantially as described, of governing the aperture through which the gas passes to the branch, of the varying pressure of the gas, beyond the valve which governs the aperture, as described, so that when the pressure becomes too great, the aperture shall be reduced, and vice versa. And I also claim, in combination with the above, making the disk so that it shall be also acted upon by the varying pressure in the branch to assist

in moving the valve to govern the aperture for the passage of the gas, substantially as specified, whereby the action of the instrument is rendered more sensitive and prompt as a governor."

DESIGNS FOR JUNE, 1853.

1. For a *Cook Stove;* John T. Davy, Troy, New York, June 21.

Claim.—"The ornamental design and configuration of jamb plate, for a cook stove, such as described."

2. For a *Cooking Stove;* John Sabey, Jr., Rochester, New York, Assignor to James K. Griffin, Waterdown, Canada West, June 21.

Claim.—"The ornamental design of a stove plate, substantially as described and represented."

3. For a *Cook Stove;* Everard Bolton, Northern Liberties, Assignor to Abram and Jos. Cox, Philadelphia, Pennsylvania, June 21.

Claim.—"The ornamental designs in bas-relief upon the doors and plates of the configuration and arrangement set forth, forming a new and original design for the cook stove, called the Triumph Complete."

4. For a *Cook Stove;* N. S. Vedder, Troy, New York, June 28.

Claim.—"The ornamental design and configuration of cook stove plates, such as described and represented."

5. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

6. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

7. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

8. For a *Parlor Stove;* Samuel D. Vose, Albany, New York; June 28, 1853; antedated May, 2, 1853.

The claim, in each of the above four patents, is, the combination of mouldings and ornaments, as arranged in the cooking stoves, A, B, C, and parlor stove, E; the whole, in each, forming an ornamental design.

9. For a *Register Face;* James Cowles, Assignor to Albert G. Bristol, Rochester, New York, June 28.

Claim.—"The new and original design for a register face, formed by the peculiar arrangement of the metallic bars, as shown in the accompanying drawing."

JULY 5, 1853.

1. For an *Improvement in Instruments for Connecting Lateral Deviations of the Spine,* Alanson Abbé, Boston, Massachusetts.

Claim.—"I claim the above described instrument, as made of a combination of the crutch, A, the hip plates, C, the plates E, I, the wedges and screws thereof, the breast or body band, L, and its pads and straps, or other contrivances for confining the whole instrument to the thigh and body, the whole being applied together and made to operate substantially in manner and for the purpose as specified."

2. For an *Improvement in Brushes;* J. Cross, New London, Ohio.

Claim.—"What I claim is, a brush consisting of a divided case to hold the handle and bristles, constructed and arranged as described, in combination with a wedge forced among the ends of the bristles within the case, and tightened from time to time, so as to squeeze and hold them, by screwing the two parts of the case together, substantially as specified."

3. For an *Improvement in Clavicle Adjusters;* A. M. Day, Bennington, Vermont.

Claim.—"I do not of itself claim a yoke to fit the neck; but what I do claim is, the arms of the yoke hollowed as described, in combination with the straps, attached and operating as described, by means of which the acromion process of the scapula is com-

pressed, and the arm held in position, for uniting a fracture of the clavicle, substantially as specified."

4. For an *Improvement in Cradle and Tete-a-tete;* George H. Hazlewood, Boston, Massachusetts.

Claim.—"What I claim is, to construct the two sides of the bed frame of the cradle, that portions of each may be turned around and arranged parallel to one another and across the bed frame, so as to convert such bed frame into a "tete-a-tete" seat or chair, substantially as specified."

5. For an *Improvement in the Manufacture of Cannon and other Fire Arms;* Chas. W. Lancaster, New Bond Street, England; patented in England, January 16, 1851.

"My improvement consists in a peculiarly shaped bore to the gun, whereby the angular groove usually cut in such arms, more particularly in rifles, is dispensed with, while the advantageous effects of such grooves are yet retained. This peculiarity of boring I also apply to cannon, as will more fully appear in the following description."

Claim.—"Is, 1st, The method of boring the barrel of a gun, or other fire arm, so that a cross section thereof would be in the form either of an ellipse or of a series of curves by the mechanism as described, or its substantial equivalent, as set forth, whereby the injurious action of the angular groove in ordinary rifles is obviated, while all its advantages are retained. 2d, The construction of the boring tool for giving to the bore a form, of which the cross section is not a true circle, that is to say, I claim the combination of the cutter-bar with the boring-tube, the said bar passing through said tube eccentrically, the axes of both being parallel, whereby the elliptical or other shaped bore is given as described; also the bar, *u*, and its inclined plane in combination with the cutter, for regulating the depth of the cut as described; also, the expanding collar, the inclined or beveled space on the boring-tube, with the other parts in connexion therewith, as described, for the purpose of guiding the boring-tool when boring out an irregularly formed cylinder, as described. 3d, The curved rail, or other like fixture, for giving the proper motion to the barrel of the gun during the boring operation, by which the spiral or twist is given as described. 4th, The cap for supporting the boring-tube, just at the moment the cutter is about to clear the muzzle, as set forth."

6. For an *Improvement in Propelling Vessels;* Thomas L. Mitchell, Birkenhead, England; patented in England, November 25, 1848.

"The invention consists of applying an instrument, in the nature of a "Bommareng," placed in a suitable axis, as a propeller for propelling vessels."

Claim.—"Is constructing the blade or blades of the same upon the principle or in the form of the "Bommareng," as described and represented."

7. For an *Improvement in Trusses;* John North, Middletown, Connecticut.

Claim.—"Is the mode herein set forth of adjusting the pressure of the pad, that is to say, by the employment of the right and left screw, and the adjusting nut, in combination with the pad lever, in the manner and for the purpose set forth."

8. For an *Improvement in Lanterns;* William Porter and Edward A. Tuttle, Williamsburgh, New York.

Claim—"Is the small rods, extending from the lower part or cup of the lantern, to the top or cap, and uniting them both together by a catch, thereby securing the globe between them in the manner substantially as described, for the purpose set forth."

9. For an *Improvement in Paddles for Vessels;* Amzi C. Semple, Cincinnati, Ohio.

Claim.—"Is the use of vulcanized india rubber, or other similarly elastic substances, which will produce the intended effect in the construction of floats of paddle wheels, for the purpose and in the manner described."

10. For an *Improvement in Crow Killers;* Noah J. Tilghman, Salisbury, Maryland.

Claim.—"Is the combination of the dart, helical spring, sliding rest or head, attached to the trigger, the trigger, and the dog, with the hollow post, in which it is placed."

JULY 12.

11. For an *Improvement in Pressure Gauges;* Edward H. Ashcroft, Boston, Mass.

Claim.—"What I claim is, the method herein described, of rendering the indications of bent-tube pressure gauges, permanent and reliable, by constructing said tubes of precious metal, as set forth."

12. For an *Improvement in Shot Chargers;* Chauncey W. Camp, Hartford, Conn.

Claim.—"What I claim is, the manner and method of making, and the application of the revolving cut-off and spring, to shot chargers, substantially in the manner and for the purpose as set forth."

13. For an *Improvement in Butter Workers;* E. J. Dickey, Hopervell Cotton Works, Pennsylvania.

Claim.—"What I claim is, the adjustable knives, arranged within the box of said machine, and operating in conjunction with the reciprocating presser, substantially in the manner and for the purpose set forth. I also claim the recess or depression, in the bottom of the box, for the purpose of preventing the butter's adhering to the presser, and being drawn back during its receding motion, substantially as described."

14 For an *Improved Apparatus for Illustrating the Motion of a Pendulum upon the Earth's Surface;* George M. Dimmock, Springfield, Massachusetts.

Claim.—"What I claim is, 1st, The application to an artificial globe, of one or more pendulums, the rods of which are formed of delicate springs, so as to vibrate evenly to all points of the dial, the plane of which is at right angles to the pendulum when at rest. 2d, I claim the bending or springing the pendulum rods, to counteract the gravity of the earth, so that when at rest they will be straight, and on the line from the point of suspension and the centre of the globe; furthermore, I claim anything substantially the same. I do not claim a ball suspended or strung on a string, or thread, and applied to an artificial globe, or applied in any manner whatever, to illustrate the rotation of the earth, by the vibration of a pendulum."

15. For an *Improvement in Tanning;* John J. Fulton, Allegheny City, Pennsylvania.

Claim.—"What I claim is, the use of muriate of ammonia in combination with nitre for the purpose of suspending putrefaction, adding strength to the animal tissues, and for usual purposes in the manufacture of leather, as set forth."

16. For an *Improvement in Hose Coupling;* Smith Groom, Troy, New York.

Claim.—"What I claim is, the spring conduit, and the appendages by which it is moved longitudinally, and is held firmly against the packing and the pads or rim in which the packing rests, to prevent the joint from leaking, in combination with the arrangement of spring bolts and their appendages, with the circular groove, for the purpose set forth."

17. For an *Improvement in Sheet Metal Beams;* Richard Montgomery, Assignor to Elizabeth Montgomery, City of New York; patented in England, October 13, 1852.

Claim.—"I am aware that plates of metal, for roofing and steam boilers, have been bent into every form by a process commonly termed corrugation for the purpose of stiffening them; but in every such case, the series of folds are comparatively shallow, and instead of the strips between the arches being parallel and in the plane of pressure, they are inclined to each other, and stand obliquely across the plane of pressure, in which position they would break down with a load that they could easily support if placed vertical and parallel as in my beam. And to a plate with such inclined strips, I therefore make no claim, as it is not suitable for a beam. But I do claim a beam formed of sheet metal, bent into a series of longitudinal folds, the sides of which are flat and parallel, and the tops and bottoms uninverted and inverted arches respectively. I also claim the combination with such a beam, of a pair of saddles to support its ends, substantially as set forth."

18. For an *Improvement in Metallic Pens;* Myer Phineas, City of New York.

Claim.—"I am aware that Perry attempted to give the proper degree of flexibility to pens, by making a transverse slot in the back, and extending it along the side of the pen, leaving a narrow spring beneath, inclined equally to the side and back of the pen, which renders it too rigid for the easy working of the pen, unless made so long that its great range of flexure renders it difficult to direct. I therefore make no claim to a side and back slot, or to a spring inclined equally to the back and side of the pen. But what I do claim is, constructing the back of the pen with a series of transverse ribs and slots, and leaving two flat springs beneath, nearly parallel to the back, and free to bend between the ribs; the effect of this construction being to give to the pen, combined stiffness and flexibility within certain limits, resembling that produced by a series of vertebral articulations, and which is formed to render the working of the pen more easy and pleasant, than any form of metallic pens heretofore essayed."

19. For an *Improvement in Coin Safe and Detector;* Henry G. Robinson, Schuylkill Haven, Pennsylvania.

Claim.—"I do not claim detecting counterfeit coin by means of a gauge and scales, for that is well known. But what I claim as new is, the peculiar construction of the implement and the manner in which the several parts are arranged; by which construction and arrangement, I combine a portable receptacle, for both coin and bank notes, convenient for the pocket, and a counterfeit coin detector. The implement being formed of a cylindrical case, having a gauge box or receptacle at one end, and the remaining portion of the case enclosing the clamps, for the purpose as shown, and otherwise constructed and arranged substantially as set forth."

20. For an *Improvement in Boring Machines;* Samuel T. Sanford, Fall River, Mass.

Claim.—"What I claim is, fitting the auger stock, by a ball and socket, or other universal joint, to an arm, which is connected with a fixed base or standard, so as to be capable of moving in arcs at any angle to each other; and giving rotary motion to the auger so arranged, by means of a pulley attached to the auger, and a band receiving motion from a pulley on a shaft, at the butt end of the pole or arm, substantially as described."

21. For an *Improvement in Adjusting Dishing Saws;* Ephraim B. Wells, Uniontown, Pennsylvania.

Claim.—"What I claim is, the adjustable rings, in combination with the concave and convex washers, as described, for the purpose of holding and regulating the saw to any required curvature."

22. For an *Improvement in Straw Cutters;* Ithamar P. Smith, Rochester, and Oran W. Seely, Albany, Assignors to Oran W. Seely, Albany, New York.

Claim.—"We claim the arrangement of the metallic guide, in combination with the knife frame and the knife formed as specified, and with the frame against whose front edge the knife is intended to play; the said last mentioned frame to be adjusted to its place by springs and screws, contained in the hollow boxes or cars, and by trunnions and shoulders, substantially in the manner set forth."

23. For an *Improvement in forming Teeth on Mill Saws;* Nathan T. Coffin, Knightstown, Indiana.

Claim.—"I do not claim the form of the chisel tooth, as teeth hooked or projecting have been made before, though not precisely of the same form as mine; neither do I claim separately the instruments for dressing and keeping the saw in order. But what I do claim is, the dies, E and C, and gauge, constructed as described, by means of which uniform chisel points are given to saw teeth by swedging, substantially in the manner and for the purpose specified. Also, the combination of the files, *r* and *g*, the block, tinned surface, and regulating screw, forming together the file gauge, by means of which, when used in combination with the beveled file, the chisel pointed saw teeth herein described are dressed, jointed, and have their edges rendered uniform, substantially in the manner specified."

24. For an *Improvement in Adjustable Screw Propellers;* Charles F. Brown, Warren, Rhode Island.

Claim.—"I am aware that others have tried to effect the same object by placing the blades one behind the other; but this arrangement renders it necessary to cut much more of the after part of the vessel, and weaken it unnecessarily and to a very dangerous extent, as is the case in the arrangement shown in the London "Mechanics' Magazine," vol. XL. p. 241. What I claim is, 1st, Arranging the pivots of the adjustable blades out of the centre of the hub, or at a distance from the axis, and carrying them right through the hub, substantially as described, whereby they obtain a greater depth of bearing, without placing one blade behind the other, and thereby rendering it necessary to cut away the after part of the vessel unnecessarily; this I claim without reference to precise means by which I turn the said pivots to adjust the blades. 2d, The employment of one of the adjustable blades of the screw propeller as a rudder in case of need, when the said blade is operated for this purpose by mechanism substantially as is described, which also serves to adjust the blades as a propeller."

25. For an *Improvement in Locks for Banks;* Linus Yale, Jr., Newport, New York.

Claim.—"What I claim is, 1st, Impressing the form of the key upon inert tumblers, or their equivalents, which shall retain said impression while being separated from the key,

and beyond reach or influence through the key-hole before they can touch the fence, for the purpose and in the manner substantially as described. 2d, I claim, in combination with inert tumblers, the cross bolt, which takes the strain of end pressure on the main bolt, and acting as a tumbler carriage, to convey the tumblers beyond reach or influence through the key-hole, when it moves them to the fence out of its locked position with the main bolt."

26. For an *Improvement in Railroad Car Seats,* Charles P. Bailey, Muskingum, Ohio, Assignor to Union Patent Sofa and Railroad Car Seat Manufacturing Company, City of New York.

Claim.—"What I claim is, so hanging a reversible car seat, whose seat when reversed forms a portion of the back, and vice versa, as that it shall occupy the same space after it is reversed that it did before, or hang between, or nearly so, the same parallel lines that it did before reversing, and so that also the seat and back may have an adjustment together, or independent of each other, substantially as described; and this I claim whether the seat is divided into two or more parts, or used without division, as herein set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Iron, and some Improvements in its Manufacture. By Mr. J. D. Morries Stirling.*

(Continued from page 41.)

Before proceeding to touch on certain other processes, which the writer believes to improve iron for special purposes, it may be well to point to some alloys of cast iron, as the making these led him to make the addition of the same and other metals to wrought iron.

The first is an alloy of iron and tin, which is extremely hard, sonorous, and capable of receiving a very high polish; the addition of manganese, and a very small per centage of zinc, gives somewhat greater tenacity. Bells made of these alloys have a pure and clear tone. Cast iron will take up from 20 to 25 per cent. of tin.

Cast iron, alloyed with zinc, becomes closer in its texture, and, as far as the writer's experiments have yet gone, stronger, and not less malleable. Alloys of bismuth, antimony, copper, and silver, possess some scientific interest, but it would be out of place to touch on them now.

Having observed the hardening effect which tin produces upon cast iron, the writer tried a similar mixture in the puddling furnace, and found a corresponding result, with this essential difference—that whereas cast iron will take up about a fifth of its weight, wrought iron is rendered too hard for subsequent working by any quantity exceeding one per cent.; and, taking the various descriptions of iron (Staffordshire, Scotch, and Welsh), one-half per cent. of tin produces a description of iron crystalline, close in texture, and harder than common wrought iron.

This quality of iron appeared to be suitable for the wearing surfaces of rails and tires of wheels, and subsequent trials which have been made have fully confirmed this opinion. Lamination is prevented, and the rail, when properly made, wears smoothly and evenly. As in all iron, and particularly in rails, much depends on manufacture; but points and crossings made of this hardened iron, and rails upon sharp inclines, where the wear previously had been very rapid, have been found to last more than

* From the London Artizan for April, 1853.

double the time of any rails previously tried, and, as they are yet not worn out, it is at present impossible to say how much longer they will last. The writer does not believe their increased duration to arise solely from the *greater hardness*, but more from the peculiar crystalline texture and fine grain of the iron resisting the lamination, which great speeds and heavy engines so rapidly produce. The sections of the rails show the proportion which it is considered best that the crystalline should bear to the fibrous iron, or to whatever other iron the rail may be composed of.

The addition of zinc, its oxides and other ores, produce the very opposite effect to tin and the other metals above named. Iron of what is called cold-short quality is rendered, by this means, fibrous, tough, and strong; red-short iron is also improved in quality by the same means, but it is found that a larger addition of zinc or its ores or oxides is required to effect an improvement in red-short than in cold-short iron. The quantity necessary to improve cold-short iron varies much in different districts, and each peculiar iron requires to be separately considered; it is also necessary to know the per centage of zinc in the ore, if ore be employed, and to ascertain that such ore does not contain foreign matters, which might counteract the effect of the zinc. The addition of these metals to the iron is best made when the iron in the puddling furnace is beginning to boil.

The writer was much gratified to observe in the American department of the Great Exhibition a confirmation of his experiments on this subject; iron, naturally cold-short and red-short, being rendered free from each of these qualities by the addition of an ore of zinc. Samples in all stages of progress were exhibited.

Table of Comparative Strength of Wrought Iron.

Description of Iron.	Tensile Breaking Strain.	Deflection. with Strain of 9½ cwt.	Permanent Set, in Lengths of 2¼ feet.	Final Stretch, in Length of 2 feet.
	Tons per in.	Inches.	Inches.	Inches.
Hardened wrought iron, with ¾ per cent. tin,	22·92	1·42	1·02	¼
Toughened wrought iron,	27·81	—	—	—
Dundyvan best bar . .	24·33	2·02	1·60	3½
S. C. Crown average result	24·47	—	—	—
Hartley's general average of bar iron . .	23·33	—	—	—

Had the limits of a mere sketch like this permitted, the writer would have entered on the consideration of the relative qualities of cold and hot blast iron, and of the effects produced by the use of cinder; also, on some combinations of iron with the earthy bases, and on the effects of various salts and fluxes in the blast and other furnaces Several other alloys of iron possess considerable interest, and, in conclusion, allusion may be made to a remarkable property which iron possesses of closing the grain of other metals and alloys to which it is added in minute quantity.

Mr. Stirling exhibited a number of specimens of the toughened wrought

iron in bars, and the hardened wrought iron, as applied to the surface of rails, showing their fractures; and specimens of the toughened cast iron, showing the mode of mixing the wrought-iron scrap with the pig metal; also specimens of an alloy of zinc, copper, and tin, and another of the same composition, with an addition of $1\frac{1}{2}$ per cent. of iron, showing the great closeness and fineness of grain that were produced by this small admixture of iron. It was explained that it was advisable to alloy the iron with the zinc before mixing with the copper, otherwise, there would be imperfection and unsoundness in the metal, the iron appearing in the form of what are technically called "tears."

The Chairman said he considered it a very important subject, and thought the paper showed valuable results of extensive practical trials combined with scientific inquiry. He asked at what period the tin or zinc was added to the wrought iron.

Mr. Stirling replied, that it was put into the puddling furnace when the extreme of the boiling was just passed, or passing, and conversion just commencing, and the formation of spicula beginning. A more fluid iron required the metal to be put in at a later period, and iron that came to mature sooner required the metal put in earlier. It was difficult to give a definite rule, it could only be judged of by particular experience.

Mr. Duclos thought the presence of zinc in the iron was doubtful; from its volatility, the greater proportion would probably be dissipated in the furnace. He considered it more probable that the change in the iron was caused by the physical quality of the iron undergoing some alteration in consequence of the presence of the zinc.

Mr. Stirling said he did not consider the mixture of zinc with the iron to be in all cases an alloy, as the proportion was occasionally only $\frac{1}{4}$ per cent., and he felt uncertain about its mode of action; the quantity of zinc required varied very much; it had to be determined by experiment with the different ores and furnaces.

Mr. Duclos observed that, in some iron works he had been acquainted with in Belgium, he had never found any trace of zinc in the iron made from ore containing zinc, but metallic zinc was found to accumulate in the top of the furnace. Many years since a series of experiments had been made by M. Carsen on various mixtures of iron with zinc and other metals, but they had not led to any practical application. There was no question that sufficient attention had not been paid to the properties of the alloys that can be made with iron, and he was glad to see the steps taken by Mr. Stirling; he did not quite agree as to the want of knowledge of the iron manufacture, he thought there was a great deal of knowledge on the subject, but he would wish the principles carried out further.

Mr. Stirling remarked that, in the case mentioned, in Belgium, two processes—smelting and refining—intervened, by which most, if not all the zinc might be volatilized. There was no doubt that the practical making of iron was well understood, but not the theory and principles, otherwise the process might be further simplified, and, as the result, iron would most probably be produced complete at one process, instead of two or more. He thought that further improvements would be more studied and accomplished when iron and coal were dearer.

Mr. M'Connell said there was great room for improvement in railway tires and rails. If the tire now lasted 70,000 miles on the driving wheel of an engine, it was considered very good work. The expense of replacing tires, and of failure, was a very serious item; and if, by Mr. Stirling's process, the iron could be made to last longer, it would be a great source of economy and convenience.

Mr. Beasley inquired why the wrought-iron scrap was put into the pig mould, in making the toughened cast iron?

Mr. Stirling replied, that one object was to insure a definite proportion for each charge; also, the wrought iron melted more easily in the furnace, when mixed in that manner with the cast iron, which seemed to act as a flux, the whole getting heated together; the cast iron dropping, eats away the wrought iron. If thrown separately into the cupola, part of the cast iron would melt down first, and the two would not get uniformly mixed; the wrought iron was liable to get oxydized, and wasted.

Mr. Beasley observed, that he was aware if the wrought iron was thrown into the puddling furnace with the pig, it would burn away and not improve the quality; but if it was thrown into the fire a little time before the puddler commenced balling his iron, it would very much improve the quality.

Mr. Stirling said that it was an old practice to add wrought iron in the puddling furnace, in order to get a quicker yield; but it would not melt thoroughly in that case, and make a uniform mixture. It should be first remelted in the cupola from the mixed pig, to make a uniform mixture, and then remelted, and worked in a puddling furnace.

Mr. Beasley remarked, that he had melted wrought iron in the cupola, and then worked it in the puddling furnace, and he had found the result to be better than from the ordinary pig iron alone; but it was not a sufficient advantage to make it worth the extra expense; he had obtained a greater yield.

Mr. Stirling observed there was a process for melting wrought iron, which was then converted back, by decarbonizing, to a state approaching to steel; it was intended to be used for small articles, such as snuffers, scissors, &c., instead of forging them.

Mr. Adams inquired about the application of the hardened iron to tires. The best scrap tires were found the worst to wear; they laminated more, and, consequently, he did not use them. Those he used were made, he believed, of two blooms, the lower one of scrap or other tough iron, and the upper one from a puddled ball not piled; the wearing surface was, consequently, crystalline iron, hard, not laminated, and was more suitable to resist the rolling and crushing action that the wearing surface of the tire was subjected to.

Mr. Stirling replied that he had seen a similar process extensively carried on; the lower part of the tire was made of No. 3 iron, and the wearing surface of No. 2 iron, consisting of two puddled balls hammered thoroughly, then reheated and passed through rolls, and lastly welded to the No. 3 iron for the lower part. For such purposes as the wearing surfaces of wheel tires and rails, scrap iron was certainly the worst, from the inequality of the pieces united by weldings, necessarily numerous and

irregular; when the wearing and rolling action came into effect, unequal wear and lamination of the surface must be the result.

Mr. T. Fairbairn said the results of the trials he had made of the toughened cast iron were a near approximation to Mr. Hodgkinson's experiments; but he did not think it would be prudent, or altogether safe, for an architect or engineer to reduce the section of a girder to the extent which the relative transverse strength given in the tables would appear to warrant; he would rather retain the large section, and avail himself of the additional security which the use of the toughened iron undoubtedly gave.

Mr. Stirling observed that, to obtain the full increase of strength, would require different trials with different iron, in order to ascertain the best proportion of scrap; but, in the right proportions, from the general results of observations, he believed it might be confidently stated that one-fifth of the weight might be taken from ordinary sections of girders, by using the toughened cast iron, leaving a greater strength of girder; however, he would much prefer seeing all the strength of the ordinary section left for extra safety. The strengths given in the tables in the paper were chiefly taken from Mr. Hodgkinson, and were the average results of his experiments, showing an increase of transverse strength of 78 per cent.

Mr. R. Williams asked whether, in practice, any difficulty was found to arise in uniting the two qualities of hard and soft wrought iron?

Mr. Stirling replied, that no difficulty was found in the manufacture, and they were found to be soundly welded together.

Mr. R. Williams observed that, as the hard iron, which melted at a lower temperature than the soft iron, was necessarily the topmost in the pile, when placed in the furnace to be welded, either that would be overheated at the expense of its quality, or the inner piles would be underheated, and endanger the soundness of the bloom. With regard to the lamination of tires, this was not so much owing to the fact of their being made of piled iron, as to the mode of piling; and, by piling the bars edgeways instead of flatways, there was little, if any, liability to laminate. Puddled iron could be made hard or soft, at pleasure, according to the management of the process, without the introduction of any alloy into the puddling furnace.

Mr. Stirling replied, that the hard iron came quite as soon to a welding heat as the other iron, and a most perfect weld resulted.

Mr. M'Connell remarked that, in the manufacture of steel tires, the steel did not lengthen so much as the iron in rolling, and it made a difficulty in rolling the tires, to make them sound throughout; and he inquired whether any difficulty of that kind was found with the hardened iron for the wearing surface of tires and wheels?

Mr. Stirling replied that, in rails, no separation between the materials had been found; he had not yet had experience in tires. On the Edinburg and Glasgow Railway, on the steep incline, at Cowlairs, Mr. Adie had had rails hardened on this plan laid down for some years, and had found them to last better than steel-covered rails, which had been also tried, and usually wore out in a considerably shorter time; the hardened rails were still going on well, and an additional portion of that line was now being laid with them. In consequence of the first rails manufactured

being made too hard, they showed distinctly a tendency to separate, and the failure was valuable as experience; also, they were made more liable to separate, by the hardened piece laid on being round-topped in the pile; 50 or 60 rails, made at the very first works where the plan had been tried, had been broken at different times, for examination, and were found quite sound.

Mr. E. A. Cowper said he had used wrought-iron scrap mixed with cast iron in the ladle, the metal being rather hotter than usual; it closed the grain of the iron very much, and was found advantageous in casting hydraulic presses, or other castings where a very close grain was required. He had put in as much as 15 per cent. of scrap.

Mr. Stirling observed that he had never found that more than about 5 per cent. could be combined in that manner, and then the mixture must be more or less imperfect, and the metal would be partially chilled.

Mr. Cowper said he had not found any objection from the metal being cooled; it was taken pretty hot, and clean iron turnings were put into the ladle, and well stirred up, which secured complete mixture and fusion.

Mr. Slaughter inquired, what was the relative cost of toughened cast iron?

Mr. Stirling replied that, in a girder, if the section were reduced one-fifth, the cost would be cheaper; if the price of cast iron were very low, the toughened iron would then be proportionately dearer.

Mr. Slaughter said he had tried the toughened iron for a number of locomotive cylinders, at the recommendation of Mr. Gooch, on the Great Western Railway, and found it made very fine, perfect, and sound castings, better than he had ever made before. He intended to continue the use of it, and considered it an excellent material for cylinder castings, and preferable for any purpose for which the strongest and best iron was required. He did not find the iron dearer, but, on the contrary, less expensive than the iron he had previously used for the purpose.

Mr. Stirling explained that the toughened iron might be made from a cheaper iron, such as the Scotch hot-blast, which, at £3 per ton, would be about £3 10*s*. for the cost of the toughened iron, which would then surpass in strength a dearer iron, such as Blaenavon, at £5 or £5 10*s*. per ton; so that, although the increased expense of the process was 10*s*. or 12*s*. per ton, the final cost was less, because a cheaper description of iron could be used, and a greater strength was at the same time obtained, as shown in the table of experiments.

Mr. Slaughter said he had found that the toughened iron was less expensive. That which he used was made from Dundyvan or Calder iron, at £3 or £3 10*s*. per ton, and he found it better, when toughened, than the cold-blast iron which he had previously used, at £5 or £5 10*s*. per ton.

The chairman proposed a vote of thanks to Mr. Stirling, for his valuable and interesting paper, which was passed. He thought that important practical results were likely to follow from such an able investigation, and they were much indebted to Mr. Stirling for bringing it before them; and he trusted that he would continue the course, and favor the institution with the further results.

Description of a new Process of Stereotype Moulds; with Notices of the History and Results of the Processes of Stereotyping. By DANIEL WILSON, LL. D., F. S. A., Scot. V. P.*

Dr. Daniel Wilson, in exhibiting this new method, stated that it was calculated to facilitate the process, and to introduce it into more general use, by diminishing the cost. In introducing the subject he reverted to the curious fact—by no means singular in the progress of inventions—that, in the economic adaptation of printing to its fullest extent, by means of stereotype plates, we are returning to a state of things nearly similar to the "block books," as they are called, which, in the beginning of the fifteenth century, preceded the great discovery of movable types, and by means of which the first essays in printing were made by Guttenberg, Faust, and Mentz. Dr. Wilson also called attention to the character of a certain class of bronze Roman stamps, of common occurrence, several of which he exhibited, both from Scottish localities and from Pompeii. These were obviously designed to be used for impressing certain characters, by means of a pigment applied to the flat surface, like types or woodcuts; and afford one of those curious examples so frequently seen in relation to modern inventions, of others—many centuries previous to their practical application—having trod, as it were, on the very threshold of the discovery. He then entered on the subject of stereotyping, or the process of taking casts from forms of movable types. The discovery of this important process was made by William Ged, a goldsmith of Edinburgh, about the year 1725; though imperfect attempts had been previously made to attain the same important end by Van der Mey, of Leyden, by soldering together the forms of ordinary movable types for a quarto bible, so early as 1711. Dr. Wilson exhibited to the meeting one of the original plates of the edition of Sallust published by Ged in the eighteenth century, and interesting, as the first specimens of the practical application of the stereotyping process ever executed. He then detailed the various efforts at further improvement on this process—including those of Brunell, Allan, Sinclair, &c.; after which he described and exhibited the new process introduced by him to the notice of the society, which consists in taking the casts of the types, not in gypsum or stucco, but in blotting paper, overlaid with a thin layer of whiting, starch, and flour-paste, covered with a sheet of tissue paper, and impressed on the types by means of beating it with a fine brush. It is then dried on a hot steam-chest, while still adhering to the types; and by this means a matrix is produced, and the types are again ready for distribution to the compositors within one hour. The advantages of the new process are—1st, The greater certainty of the process, the new matrix not being liable to warp or break, as the stucco is. 2d, The greater rapidity; the process being completed in one hour by it, which could not be done in less than six by the other. 3d, The practicability of using the matrix, in certain cases, for casting several plates; whereas the stucco mould is always destroyed in a single casting. And, 4th, The much greater simplicity of the apparatus required; which, added to the economy of time, and the consequent diminution of the

* From the London Artizan, April, 1853.

quantity of type required for the compositors, give the important economic results which form the great merit of the new plan. A mould was made and a cast taken in presence of the meeting; and Dr. Wilson concluded by remarking that he believed it was by the improvement and more general application of such processes as this, that the great desideratum of cheap literature was to be achieved, and not by diminishing the profits of retail booksellers, as had recently been attempted. If publishers could be induced to try it, there was no real obstacle in the way of applying the stereotyping process, with all its adjuncts, to such standard works as Layard's "Nineveh," or Macaulay's "History of England," than to Mrs. Stowe's "Uncle Tom;" and if the publisher calculated his price for editions of ten, twenty, or thirty thousand of the one, as they had already done of the other, people would learn to purchase, instead of merely borrowing a hasty reading from some lending library. This, he thought, was the direction in which we must now look for securing the grand desideratum of cheap literature of the highest class, in a way that would secure at once the best interests of author, publisher, and readers; whereas, by reducing the profits of the retailer on the present costly two or three guinea editions, the price was, in reality, brought no nearer the means of the ordinary reader; while the bookseller's interest in their sale, and even in their publication, must be greatly diminished with the increase of his risk; and the chance of sale of costly and valuable books was thereby not unlikely to be diminished.

For the Journal of the Franklin Institute.

U. S. Screw Steamship Princeton. By B. F. Isherwood, Chief Engineer U. S. Navy.

Continued from page 51.

Performance with the Ericsson Screw.

The following table gives the result of all the steaming done with the Ericsson screw recorded in the log; much more steaming was done with it than is here given, but no record was kept of the performance of the machinery.

The data in the table is wanting in several elements; the consumption of fuel, the proportion of the throttle open, and the condenser back pressure, are not given. I have been informed, however, by the engineers of the vessel at that time, that the throttle was carried about $\frac{1}{4}$th open, and the steam pressure maintained by driving the fan blast very strongly, the back pressure in the condenser averaging 2 pounds per square inch. Under these circumstances, the initial cylinder pressure would be about 3 pounds less than the boiler pressure.

But the data in the table is chiefly valuable as giving the *slip* of the Ericsson screw in sea navigation, and although the means are derived from a less extensive course of steaming than could be desired to ensure positive certainty, yet they are from a sufficient number of observations taken under different circumstances of weather to give the results with enough accuracy for practical purposes.

Table of the Performance of the U. S. Screw Steamship Princeton, with the first boilers and Ericsson's Screw, under Steam assisted by Sail, on the Atlantic Coast of the United States.

DATE.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ feet.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	ENGINES. Steam pressure in boilers per sq. in. above atmos.	ENGINES. Steam cut off at from commencement of stroke.	ENGINES. Double strokes of piston made per minute.	Slip of the screw in per centums of its speed.
								ft. in.	lbs.			
1844. Mar. 15,	10	6·000	N. by E.	E. or abeam.	Moderate Wind.	To topsails.	Rough.	15 8	19·3	1/3	28·70	39·44
Nov. 26,	24	8·719	S. by W.	Abeam.	Fresh breeze.		Moderate.	17 4	16·5	"	29·50	14·55
1845, Jan. 8,	21	8·798	N.	N. E. or forward beam.	Moderate Wind.		"	16 9	15·4	"	27·70	8·00
Feb. 2,	6	8·000	W.	N. or abeam.	Fresh breeze.		"	17 0	13·8	"	25·00	7·31
" 4,	7	8·000	S. W.	N. W. or abm	"		"	16 6	14·6	"	25·00	7.31
" 21,	3	8·667	S. E.	S. W. or abm	Moderate brreeze.		"	17 0	15·7	"	28·33	11·40
Means,		8·226						16 9⅝	16·1	1/3	27·98	15·01
Performance under Steam, unassisted by Sail.												
1844. Jan. 2.	15	7·733	N. E.	N. E. or ahead.	Moderate breeze.	None.	Smooth.	16 8	16·8	1/3	31·26	28·34
Feb. 11.	12	8·083	S. W.	N. W. or abeam.	Fresh breeze.		"	17 6	18·2	"	31·25	25·08
Mar. 14.	13	5·365	N. E.	N. or forward beam.	Moderate Wind.		Rough.	15 10	20·5	"	28·77	45·99
Nov. 27.	18	5·250	S. W.	W. or " "	Strong Wind.		Heavy ahead.	17 6	15·5	"	26·11	41·76
Dec. 9.	24	8·333	N.	N. or ahead.	Moderate breeze.		Smooth.	17 0	16·6	"	29·46	15·61
1845. Jan. 6 & 7.	7	8·071	S.	N. or aft.	Light airs.		"	16 10	13·7	"	27·07	13·62
" 24	8	6·000	E. S. E.	S. E. or ahead.	Moderate Wind.		Rough.	17 6	15·0	"	25·95	26·33
Feb. 2.	18	5·417	N. W.	N. N. W. or ahead.	Fresh Wind.		"	17 0	14·5	"	23·05	31·93
" 3.	10	8·600	N.	Forward the beam.	Light. breezes.		Moderate.	16 9	14·5	"	26·00	4·19
" "	6	5·710	NE by E	S. or on quar	Light airs.		Smooth.	16 9	7·7	"	17·17	3·67
" 4	17	6·280	N. W.	N. W. or ahead.	Moderate breezes.		Moderate.	16 7	15·2	"	24·00	24·21
" 22 & 23	38	7·069	S. W.	S. or forward beam.	Light breeze.		Smooth.	16 10	15·0	"	27·67	26·00
Means,		6·912						16 10½	15·6	1/3	26·98	25·79

Summary of the Results with the Ericsson Screw.

	Performance under steam assisted by sail.	Performance under steam unassisted by sail.	Mean of the total performance.
Total number of hours,	71	196	267
Speed of the vessel per hour in knots of 6082⅔ feet,	8·226	6·912	7·261
Steam pressure in boilers in lbs. per sq. in. above atmosphere,	16·1	15·6	15·7
Proportion of throttle open,	1/4	1/4	1/4
Initial steam pressure in cylinders in lbs. per sq. in. above atmos.,	12·1	11·6	11·7
Steam cut off at from commencement of stroke of piston,	1/3	1/3	1/3
Back pressure in condensers in pounds per square inch,	2	2	2
Mean effective pres. in lbs. pr sq. in. of pistons throughout stroke,	15·3	14·9	15·
Horses power developed by the engines,	404·23	379·59	386·14
Double strokes of piston made per minute,	27·98	26·98	27·25
Slip of the screw in per centums of its speed,	15·01	25·79	22·92
Mean draft of vessel in feet and inches,	16 9⅝	16 10½	16 10¾
Immersion of the centre of the screw below the surface of the water,	9 9⅝	9 10½	9 10⅜
Immersed amidship section of the hull in square feet,	358·	360·5	360·5
Displacement of hull in tons,	1028·5	1037·4	1035·3

Performance of the U. S. Screw Steamship Princeton, with the first boilers and Stevens Screw, under the command of Commodore Stockton, in the Atlantic Ocean and Gulf of Mexico.

Date. 1845.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	Slip of the screw in per centums of its speed.	ENGINES. Steam pressure in boilers per sq. in. above atmosphere.	ENGINES. Double strokes of piston made per minute.	ENGINES. Steam cut off at from commencement of stroke.	Anthracite burned per hour with fan blast.
								ft. in.		lbs.			lbs.
April 7,	14	9·100	N. E. by N.	S. or on qur.	Light breeze.	All sail.		17 0	17·09	18·0	34·30	⅓	2700
May 6,	10¼	7·400	W.	E.by S.or aft.	"	"		17 8	11·35	6·8	20·50	"	1040
" 8,	12	9·200	W by N	N. or abeam.	"	"		17 6		12·7	28·40	"	2217
" 9,	24	9·067	"	"	Mod. wind	"		17 6	3·19	10·6	27·46	"	1715
" 10,	24	8·567	"	"	Light "	"		17 4	2·22	9·5	27·38	"	1434
" 11,	11	8·705	N. W. by W.	N. or forw'd. the beam.	"	"		17 3	1·44	10·0	27·60	"	1042
" 11,	7	7·250	"	N.W. or abd.	"	No sail.		17 3	9·37	10·0	25·00	"	1022
" 12,	10	8·100	N. W.	N. E. or abm.	"	All sail.		17 2	1·66	9·9	24·90	"	960
June 25,	16	8·531	E.by S.	E. S. E. or ahead.	Moderate breeze.	No sail.		17 3	8·07	12·3	29·00	"	1440
" 26,	8	8·375	S. E. by E.	E. or forw'd. the beam.	"	"	Smooth.	17 1	11·28	12·2	29·50	"	1224
" 26,	16	8·797	E.	E. or ahead.	"	"		16 11	6·20	12·2	29·31	"	1352
" 27,	24	8·427	S. E. by E.	S. E. or ah'd.	"	"		16 9	10·35	12·1	29·38	"	1344
" 28,	20	7·412	E.	E. or ahead.	"	"		16 8	18·88	12·0	28·55	"	1208
" 28 and 29,	18	8·903	N. E. by E.	E. or forw'd. the beam.	Fresh brez	All sail.		16 6	1·72	10·6	28·31	"	1181
June 29,	8	7·406	N.	W. or abeam.	Light "	"		16 6	2·05	6·0	23·63	"	624
" 30,	24	8·354	N N E.	W. or on qr.	Fresh "	"		16 6	1·90	7·8	25·62	"	720
July 1,	8	7·750	"	N'd. & W'd. or abeam.	Light "	"		16 4	9·46	12·0	26·75	"	804
" 1,	16	5·719	"	N. E. or ah'd.	Mod. "	No sail.		16 4	24·75	9·8	23·75	"	768
" 2,	24	6·692	N. E.	N'd. & E'd. or ahead	Light "	"		16 3	16·48	8·0	25·04	"	844
" 3,	20	8·250	N. W.	N'd. & E'd. or abeam.	Mod. "	All sail.		16 2	1·41	6·8	26·15	"	674

Summary of the Results from the above Table.

	Performance under steam assisted by sail.	Performance under steam unassisted by sail.	Mean of the total performance
Total number of hours,	183½	131	3 4½
Speed of the vessel per hour in knots of 6082⅔ feet,	8·515	7·615	8·140
Steam pressure in boilers in lbs. per sq. in. above atmosphere,	10	11	10·4
Proportion of throttle open,	¼	¼	¼
Initial steam pressure in cylinders in lbs. pr sq. in. above atmos.,	6	7	6·4
Steam cut off at from commencement of stroke of piston,	⅓	½	½
Back pressure in condensers in pounds per square inch,	2	2	2
Mean effective pres. in lbs. pr sq. in. of pistons throughout stroke,	10·7	11·4	11·0
Horses power developed by the engines,	274·01	295·92	283·14
Double strokes of piston made per minute,	27·12	27·49	27·27
Slip of the screw in per centums of its speed,	1·88	13·43	6·69
Mean draft of vessel in feet and inches,	16 11	16 7⅜	16 9½
Immersion of centre of the screw below the surface of the water,	9 ·1	9 7⅜	9 9½
Pounds of anthracite burned per hour with a fan blast,	1283	1147	1226
Immersed amidship section of the hull in square feet,	361·8	352·6	358
Displacement of the hull in tons,	1041·1	1007·9	1027·4

Table of the Performance of the U. S. Screw Steamship Princeton, under the command of Capt. Engle, with the first boilers and Stevens Screw, under steam assisted by sail, in the Atlantic Ocean and Gulf of Mexico.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082½ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel. ft.	Mean draft of vessel. in.	Slip of the screw in per centums of its speed.	ENGINES. Steam pres. in boil. pr sq. in. abv. atmo.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with moder. fan blast.
											lbs.					lbs.
Sept. 7 and 8, 1845,	43	7·400	S. W. ½ W.	S. E. or abeam.	Gentle brez.	"	"	17	3	1·17	8·7	23 40			2·2	1120
" 9 " 10, "	31	6·100	"	N. E. or aft.	Light "	"	"	17	1	11·75	9·4	21·60			2·2	851
Oct. 1, 2 and 3, "	60	7·587	S. W.	S. E. or abeam.	Mod. "	"	Moder.	17	5	11·53	11·0	26·80			2·2	1652
July 17 and 19, '46,	24	7·460	N. E.	Abaft the beam.	" "	To topsails.	Smo'th	16	4	1·42	12·3	23·65			3·2	859
" 30 and 31, "	24	7·750	S. S. W.	E. or abaft the beam.	" "	To royals.	"	17	11	2·50	10·6	23·63		·32	2·2	923
August 22, "	3	8·750	S. E. by E.½E.	S. S. E. or forward beam.	" "	Fore&aft sails.	Moder.	17	6	1·27	10·0	27·00			2·7	1700
September 6, "	12	7·667	N. N. E. ½ E.	N'd. & E'd. or for'd. beam.	" "	"	Smo'th	18	0	10·60	11·8	26·80			4·2	1360
" 7, "	8	8·000	"	" " "	Light "	To topsails.	"	17	10	3·84	12·3	26·00		3-16	4·2	1350
" 9 & 10, "	42	8·810	"	Abeam.	Mod. "	To topgallants	"	17	7	2·35	13·2	28·20		7-32	4·2	1724
" 14 & 15, "	36	8·000	S. S. E.	E. or abeam.	" "	"	"	18	1	4·25	12·5	26·11		7-32	3·5	1761
" 16, "	18	7·800	S. by E.	" "	" "	To royals.	"	17	11	0·51	12·7	24·50		⅛	3·7	1450
" 17, "	7	6·730	S. E. ½ S.	E. or forward the beam.	" "	Fore&aft sails.	Moder.	17	9	10·07	13·0	23·57		3-16	3·4	1429
" 19 & 20, "	23	6·217	S. S. E.	" " "	Strong "	"	Rough.	17	6	12·25	13·0	22·14		3-16	3·4	1552
Oct. 2 and 3, "	36	5·200	N. N. E.	" " "	Light "	To topgallants	Smo'th	16	6	18·62	7·6	13·70		1-32	4·4	511
Oc. 31, & Nv. 1, "	39	5·570	S. S. W.	W. N. W. or abeam.	Mod. "	"	Moder.	17	8	19·41	10·5	21·60		5-32	3·7	1146
Nov. 2 and 3, "	36	6·717	"	E. or abeam.	" "	"	"	17	6	4·58	10·4	22·00		3-16	3·7	1183
" 3 and 4, "	15	6·600	"	" "	Light "	"	"	17	5	6·08	9·5	21·96		⅛	3·2	1114
" 4 and 5, "	27	6·900	"	N. W. or on quarter.	Mod. "	"	"	17	4	5·38	10·6	22·79		3-32	3·4	933
January 25, 1847,	12	6·400	W. ½ S.	N. or abeam.	Light "	"	"	16	8	10·31	10·0	22·30		¼	3·	1356
Mar. 29, 30, 31, "	54	7·156	N. N. E. ½ E.	E. or abeam.	Mod. "	"	Smo'th	17	9	12·27	9·7	25·49		¼	2·5	1656
Means.		7·071						17	5	6·46	10·7	23·61		·170	3·1	1290

Table of the Performance of the U. S. Screw Steamship Princeton, with the first boilers and Stevens Screw, under steam alone, in the Atlantic Ocean and Gulf of Mexico.

DATE.	Number of hours.	Speed of the vessel per hour, in knots of 6085⅓ feet.	Course of the Vessel.	WIND. Direction.	WIND. Kind.	Sea.	Mean draft of vessel. ft.	Mean draft of vessel. in.	Slip of the screw in per cents. of its speed.	ENGINES. Steam pressure in boiler per square inch above atmos.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from commencement of stroke.	ENGINES. Proportion of throttle open.	ENGINES. Back pressure in condenser per gauge.	Anthracite coal burned per hour with moderate fan blast.
										lbs.				lbs.	lbs.
August 7, 1845.	14	6·278	S.	S. E. or for'd the beam.	Light breeze.	"	17	0	10·00	10·5	21·80	½	2-16	2·	1083
September 5 and 6, "	32	7·400	S. W. ½ W.	S. W. or ahead?	" "	"	17	6	15·91	11·4	27·50	⅓	¼	2·2	1600
Sep. 15, 16, 17, 18 & 19, "	101	7·399	N. E.	N. E. or ahead.	Gentle "	"	16	8	15·83	11·7	27·47	"	¼	2·2	1508
October 3 and 4, "	24	8·000	S. S. W.	S. W. or ahead.	Light "	Smooth.	16	4	9·76	10·8	27·70	"	¼	2·2	1854
Oct. 24, 25, 26 & 27, "	96	5·240	N. N. E.	N. and E. or ahead.	Fresh wind.	Heavy head sea.	16	9	32·89	11·2	24·40	"	¼	1·2	2154
May 12 and 13, 1846.	25	7·000	S. S. W.	S. S. W. or ahead.	Light breeze.	Ordinary.	16	0	8·85	11·4	24·00	"	9-32	2·7	1402
" 20 and 21, "	25	6·682	S. by W ½ W.	N. E. or on quarter.	Light airs.	Smooth.	17	10	8·00	12·4	22·70	"	7-32	2·7	1139
July 14, 15 and 16, "	49	6·555	N. N. E.	N. E. or ahead.	Mod. breeze.	"	16	7	13·93	12·6	23·80	"	⅛	2·2	1120
" 19, "	12	5·750	N. N. E. ½ E.	E. S. E. or abeam.	" "	Moderate.	16	5	21·87	13·0	23·00	"	5-32	3·	1067
" 29, "	12	6·481	S. S. W.	S. E. or abeam.	Light airs.	Smooth.	17	10	8·00	12·0	23·50	"	3-16	2·2	1442
August 1, "	6	6·000	S. S. W. ½ W.	"	Light breeze.	"	18	0	14·77	9·8	22·00	"	3-16	2·2	900
September 7 and 9, "	31	8·001	N. N. E. ¾ E.	"	" "	"	17	9	8·00	12·8	27·18	"	⅛	2·2	1726
" 17, "	8	7·367	S. E. ½ S.	N. E. or ahead.	Gentle "	Moderate.	17	9	9·00	13·0	25·30	"	⅛	4·2	1870
" 17, 18 & 19, "	37	6·430	S. E.	Variable.	Mod. "	"	17	8	17·92	13·3	24·48	"	¼	3·7	1892
" 19, "	9	6·333	S. ½ E.	E. S. E. or for'd. beam.	" "	"	17	7	14·69	12·7	23·20	"	7-32	3·7	1533
" 21 and 22, "	36	6·111	S. by E. ½ E.	E. or abeam.	" "	Long swell.	17	4	15·24	12·7	22·53	"	3-16	3·7	1548
October 1 and 2, "	15	3·900	N. N. E	S. E. or for'd the beam.	Gentle "	Smooth.	16	7	8·00	12·7	23·23	"	3-16	3·7	637
November 3, "	3	5·000	S. S. W.	S. and E. or on quar.	Mod. "	Moderate.	17	6	23·02	8·9	20·30	"	1-32	4·7	1200
" 3 and 4, "	24	6·412	"	S. W. or ahead.	Light "	"	17	5	8·33	10·0	21·86	"	3-16	3·7	1154
" 12 and 13, "	31	5·174	N. by W. ¾ W.	S. E. or abeam.	Light airs.	Smooth.	17	2	25·14	9·3	21·60	"	5-32	3·2	1105
" 17 and 18, "	19	3·184	—	N. W. or for'd the beam.	Gale.	Heavy head sea.	16	10	46·47	10·5	18·59	"	3-16	3·	1248
" 20, "	12	5·400	N. W.	Ahead.	Strong wind.	Mod. head sea.	16	9	15·60	9·9	20·00	"	3-16	3·7	1183
January 26, 1847.	20	6·000	W. ½ S.	N. W. or ahead.	Calm.	Smooth.	16	9	15·92	9·8	22·30	"	3-16	3·5	1160
Means,		6·343		N. or abeam.			17	1	17·79	10·5	24·11	⅓	¼	3·	1511
													·216	2·9	

Table of the Performance of the U. S. Screw Steamship Princeton, with the last boilers, under steam assisted by sail, in the Atlantic Ocean and Mediterranean Sea.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082½ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	Slip of the screw in per centums of its speed.	ENGINES. Steam pres. in boil. pr sq. in. abv. atmos.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with a mod. fan blast.
								ft. in.		lbs.				lbs.	lbs.
July 25 & 26, 1847,	24	9·542	E.	S. or abeam.	Fresh breez.	To topgallants	Moder.	17 6	20·7	12·2	24·71		1-31	2·2	854
" 30, "	18	5·830	E. by S.	S. S. W. or for'd beam.	Light "	"	"	17 4	27·19	10·6	23·60		1-24	2·2	968
August 2, "	8	7·000	S. E.	E. N. E. or for'd. beam.	Gentle "	To topsails.	Smo'th	17 1	9·79	13·0	24·25		1/8	2·2	925
" 10, 11&12 "	47	8·413	S. E. by E.	S. W. or abeam.	Mod. "	To topgallants	Moder.	17 3	5·76	11·8	27·90		3-16	2·2	1294
" 13 & 14, "	40	8·224	"	N. E. or abeam.	" "	"	"	17 1	4·03	11·6	26·88		3-16	2·2	1428
September 13, "	10	6·200	"	S. W. or abeam.	Gentle "	"	Smo'th	16 8	13·89	12·5	22·50		1/8	3	845
" 22, "	7	5·430	E. N. E.	S. E. or forward beam.	Light "	To Topsails.	"	17 5	21·33	11·5	21·57		1/8	3	914
Dec. 3 and 4, "	36	6·143	E. by S.	N. E. or forward beam.	Mod. Gale.	"	Rough.	17 6	20·01	11·7	24·00		3-16	2·5	1167
" 5, "	21	8·100	"	" "	Strong wind	"	Moder.	17 5	5·72	13·0	26·85		3-16	2·	1154
January 7, 1848,	12	7·830	W. by N.	S. W. or forward beam.	Mod. breeze.	"	"	16 9	7·97	11·5	26·59		1/4	2·5	1467
" 26, "	3	7·500	E. by S.	N. or abeam.	Light "	"	"	16 10	15·39	12·7	27·67		1/4	2·5	1697
March 5 and 6, "	14	7·150	"	S. W. or on quarter.	" "	"	Smo'th	17 2	9·03	12·3	24·64		3-16	2·5	1915
" 19, "	12	7·333	N. N. E. ¾ E.	E. by S. or abeam.	Moderate.	Fore, aft & courses.	"	16 9	15·12	12·3	27·00		1/4	2·5	1824
Means,		7·580						17 2½	7·76	12·3	25·68		·163	2 3	1253

Table of the Performance of the U. States Screw Steamship Princeton, with the last boilers, under steam unassisted by sail, in the Atlantic Ocean and Mediterranean Sea.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082½ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sea.	Mean draft of vessel.	Slip of the screw in per cents of its speed.	ENGINES. Steam press. in boil. pr sq. in. abv. atmo.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with a mod. fan blast.
									lbs.				lbs.	lbs.
July 31, & Aug. 1 & 2, '47,	64	6·303	S. E.	S. E. or ahead.	Light breeze.	Smooth.	17 3	17·96	11·9	24·01	⅛	⅛	2·5	1093
August 3, 4, 5, 6, & 7, "	106	6·218	S. E. by E.	" "	Strong "	Rolling.	16 10	20·14	12·2	24·33	⅛	⅛	2·5	1193
" 13, "	5	7·600	"	S. W. or abeam.	Light "	Moderate.	17 1	8·65	11·8	26.00	⅛	3-16	2·5	1444
September 10 and 11, "	32	4·155	"	S. E. or ahead.	Mod. Gale.	Very Rough.	16 10	38·34	13·4	21·06	⅛	⅛	3·	1182
" 16, "	9	5·000	N. E.	N. E. by E. or ahead.	Mod. breeze.	Smooth.	16 9	32·36	12·0	23·10	⅛	3-16	3·2	1438
" 21, "	4	5·750	E.	——	Calm.	"	17 6	20·14	12·0	22·50	⅛	⅛	3·	828
" 22 and 23, "	10	5·856	N. E.	——	"	"	17 5	15·47	12·7	21·65	⅛	⅛	3·	830
" 28, "	9	6·220	S. E.	E. or forward the beam.	Strong breeze.	"	17 6	21·53	12·0	24·77	⅛	⅛	3·	1245
" 29, "	18	5·330	E. by N.	E. or ahead.	" "	Moderate.	17 5	30·01	13·0	23·80	⅛	⅛	3·	1170
October 6 and 7, "	13	5·700	S. S. E.	S. E. or for'd. the beam.	Light "	Smooth.	17 5	21·53	12·3	22·70	⅛	⅛	2·7	1008
Oct. 12, 13 and 14, "	42	5·452	S. E.	S. or forward the beam.	Strong "	"	17 2	25·27	12·2	22·80	⅛	3-16	2·7	2153
Nov. 3, "	15	5·400	E. by S.	N. E. or for'd the beam.	Light "	"	17 6	28·80	13·0	23·70	⅛	3-16	2·5	1177
" 12, "	6	5·670	S. W. by S.	N. N. W. or on quarter.	Strong "	Rough.	16 9	26·70	13·0	24·17	⅛	3-16	2·5	1100
" 14 and 15, "	10	6·500	S. W. ½ S.	(Not given.)	Light "	Smooth.	17 6	17·43	13·8	24·60	⅛	3-16	2·6	1160
December 28, "	5	6·150	S. E. by S.	N. E. or abeam.	" "	"	17 2	23·12	14·0	25·00	⅛	3-16	2·2	1120
January 6 and 7, 1848,	32	6·375	W. by N.	S. W. or for'd the beam.	" "	"	16 9	19·55	12·0	24·75	¼	¼	2·5	1250
" 21 and 22, "	17	7·294	N. E.	N. W. or abeam.	Light airs.	"	17 6	15·58	11·7	27·00	¼	¼	2·5	1527
" 25 and 26, "	15	6·328	W. by N.	N. W. or for'd the beam.	Strong breeze.	Moderate.	16 10	23·53	11·8	25·86	¼	¼	2·5	1619
" 27, "	10	7·400	E. by S.	S. E. or for'd the beam.	Light "	Smooth.	16 8	13·61	10·8	26·60	¼	¼	2·5	1662
March 2 and 3, "	20	5·150	W. by N.	W. by N. or ahead.	Strong wind.	Rough head sea.	17 6	33·08	12·0	24·05	¼	¼	2·2	1615
" 15 and 16, "	16	5·683	"	S. W. or for'd the beam.	Strong breeze.	Smooth.	17 0	28·07	12·5	24·69	¼	¼	2·2	1865
Means.		5·932					17 0	22·76	12·3	24·00	¼	·168	2·5	1245

Summary of the Performance of the U. S. Screw Steamship Princeton, while under the command of Captain Frederick Engle, U. S. Navy, embracing all the Steaming done between July 25, 1845, and July 17, 1849, recorded in the Steam Logs at the Navy Department.

	With the first boilers and Stevens' screw, in the Atlantic Ocean and Gulf of Mexico.			With the last boilers and Stevens' screw, in the Atlantic Ocean & Mediterranean Sea.		
	Under steam assisted by sail.	Under steam alone.	Mean of total steam'g with and without sail.	Under steam assisted by sail.	Under steam alone.	Mean of total steam'g with and without sail.
OBSERVED.						
Total number of hours, . .	550	641	1191	252	458	710
Speed of vessel per hour in knots of 6082⅔ feet, . . .	7·071	6·343	6·680	7·580	5·932	6.517
Steam pressure in boilers in pounds per square inch above atmosphere,	10·7	11·5	11·1	12·3	12·3	12·3
Steam pressure in cylinders in pounds per square inch above atmosphere,	5·7	7·5	6·6	7.3	7·3	7·3
Double strokes of piston (and revolutions of screw) per minute, .	23·61	24·11	23·88	25·68	24·00	24·60
Steam cut off at from commencement of stroke of piston, . .	⅓	⅓	⅓	⅓	⅓	⅓
Proportion of throttle open, .	·170	·216	.195	·163	·168	·166
Back pressure in condensers, in lbs. per square inch, . .	3·1	2·9	3.	2·3	2·5	2·4
Pounds of anthracite coal burned per hour, with a moderate fan blast,	1290	1511	1409	1253	1245	1248
Tons of anthracite coal burned per 24 hours, with a moderate fan blast,	13·82	16·19	15·10	13·42	13·34	13·38
Mean draft of vessel in feet and inches,	17·5	17·1	17·3	17·2½	17·0⅜	17·1¼
Immersion of centre of screw below surface of water in feet and inches,	10·5	10·1	10·3	10·2½	10·0⅜	10·1¼
Immersed amidship area of hull in sq. ft	376·7	364·3	371·8	370·5	365·2	368·
Displacement of the hull in tons,	1096·1	1050·3	1077·8	1073·2	1053·7	1061·7
CALCULATED.						
Slip of screw in per cent. of its speed,	6·46	17·79	12·58	7·76	22·76	17·21
Mean effective pressure on pistons in pounds per square inch, .	9·40	9·95	9·70	11·40	11·20	11·27
Horses power developed by engines,	209·56	226·52	218·67	276·43	253·82	261·84
Pounds of coal burned per hour per square foot of grate surface, .	9·627	11·276	10·515	9·213	9·155	9·176
Pounds of coal burned per hour per sq. foot of heating surface, .	0·533	0·624	0·582	0·418	0·415	0·416
Cubic feet of steam of atmospheric pressure furnished per minute, from sea water of twice the natural concentration, with temperature of feed water 100° F., inclusive of loss by blowing off to maintain that concentration, and of loss between valves and pistons and in steam ports, but *exclusive* of the steam required to work the fan blast, . .	. . .	. . .	3689·850	. . .	. . .	3926·524
Pounds of steam evaporated per hour, from one square foot of heating surface, under the above conditions,	. . .	. . .	3·363	. . .	. . .	2·887
Pounds of steam evaporated per hour, by one pound of coal, under the above conditions, . .	. . .	. ..	5·777	. . .	. . .	6.940

*A Hint Respecting the Barometer.**

The purpose for which the Barometer was originally designed, and which ever since its invention it has been supposed actually to accomplish, is *to measure the weight* of the atmosphere, and this it certainly does effect in one sense of the word, but not in its generally received sense. By the weight of any heavy body, such as a cannon ball or a carriage wheel, we invariably understand the weight of that body when free from motion, and this weight is always a just criterion of the quantity of matter which the body contains; but in weighing the air by the barometer, we only obtain its weight modified by the degree of speed with which it may be passing along at the time. Its barometric weight, therefore, except in a perfect calm, without either upper or lower current, which perhaps seldom or never happens, must perpetually differ from its real or dead weight, and for this reason cannot rightly be regarded as a perfect measure of its mass. Hence it is plain that if the air is a fluid with a well defined surface covering the earth in a simular manner to the sea, and subject to elevations and depressions resembling the tides of the ocean, these atmospheric tides increasing or decreasing at any place in proportion to the volume of air collected there, can never be accurately ascertained by the barometer without reference also to the velocity of the wind, by making due allowance for which we alone can arrive at its real weight, and consequently at its quantity. In order to obtain a rough estimate of the amount of the correction which it thus appears to be necessary to introduce into the readings of barometric observations on this account, I took for data those recorded in the *Nautical Magazine* for the years 1835 and 1836. In the column marked "Force of the Wind," the minimum degree, or No. 1, was first searched for, there being no calm noted during those years, and wherever that number occurred, the heights of the barometer, given in the parallel columns, were carefully extracted. The mean of them was then taken, and in like manner the mean corresponding with every other degree of force up to No. 11, which is the highest registered. The following is the result of these calculations:—

Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.
No. 1	30·19	No. 4	29·92	No. 7	29·67	No. 10	29·51
2	30·03	5	29·87	8	29·54	11	29·40
3	29·98	6	29·77	9	29·49		

By this table it will be seen at a glance that the barometer falls with every degree of increase in the velocity of the wind, and not only is this the case, but I think it will appear also that this fall of the mercury proceeds according to a known natural law. In treating of centrifugal motion, it is usual to illustrate it by supposing a heavy body, a ball or bullet for instance, attached to the end of a string, whilst the other end is held in the hand, and thus becomes a central point, around which the bullet is made to revolve. By this revolution the string receives a pull outwards,

* From the Nautical Magazine, May 1853.

the force of which may be completed by the following proportion.—(See Barlow's *Math. Dict.* Art.: Central Forces.)

As the radius of the circle it describes
Is to double the height due to its velocity;
So is the weight of the body,
To its centrifugal force.

Applying this rule to the motion of the air round the earth, we must suppose the atmosphere to be the bullet, and the earth's radius the string; then calling the latter r, and the weight of the former b, and putting v for the velocity of the wind in feet per second, $2g = 32\frac{1}{6}$ for the force of gravity, and f for the centrifugal force, we shall have, from the laws of falling bodies, according to the same author,

$$4\ g^2 : v^2 :: g : \frac{v^2}{4g} = \text{the height due to its velocity.}$$

Whence, by the same proportion,

$$r : \frac{v^2}{2g} :: b : \frac{bv^2}{2gr} = f, \text{ the centrifugal force.}$$

Now if we multiply the square of v by b, which latter, if it be made to represent the average weight of the air, is a constant quantity, and if we divide the product by $2g = 32\frac{1}{6}$, which is also a constant quantity, and by r, or the radius of the earth, which is another constant quantity, then as v^2 is the only variable quantity, the results will only vary with this quantity, and in the same proportion. Consequently f, or the centrifugal force with which the air is pulled upward by the wind, is directly as the square of the velocity; and this force, expressed in terms of the barometric scale, being added to the observed height, will give the true height, corresponding to the dead weight of the superincumbent air.

It now remains to show how far this theory accords with observation, and for this purpose I place the results of each side by side.

Force of Wind.	Number of Observations.	Mean Barometer.	Barometer according to Theory.	Force of Wind.	Number of Observations.	Mean Barometer.	Barometer according to Theory.
No. 1	190	30·19	30·02 01	No. 6	139	29·77	29·77 11
2	255	30·03	30·01 03	7	82	29·67	29·66 13
3	355	29·98	29·98 05	8	45	29·54	29·53 15
4	196	29·92	29·93 07	9	14	29·49	29.38 17
5	247	29·87	29·86 09	10	14	29·51	29·21 19
6	139	29·77	29·77	11	5	29·40	29·02

The perfect agreement of seven of these results, from Nos. 2 to 8 inclusive, out of eleven, is most remarkable. Had the observations been

more numerous from which the remaining four were derived, the latter three in particular, there is every reason to believe that the same agreement would have been apparent. Whether the winds classed under the first degree in the meteorological register could have fallen short of the force assigned to them, and ought to have been reckoned as 0, I know not, but so we should be led to suspect from the above hypothesis, and also that 3, 4, 5, &c., should be twice, thrice, &c., the velocity of No. 2, instead of three, four, and five times that of No. 1. But, however we may decide upon this point, the results will still be found in sufficiently close accordance with observation, to prove beyond doubt the correctness of the theory on which they are founded. J. N.

For the Journal of the Franklin Institute.

United States Auxiliary Screw Steamship Massachusetts. By B. F. Isherwood, Chief Engineer, United States Navy.

Continued from page 63.

The Massachusetts as a Sailing Vessel.—The following is the performance of the *Massachusetts* under sail alone, the screw being hoisted entirely out of water. As much sail was carried as could be advantageously set, and the sea was generally in its ordinary state, with a moderate swell on.

				Knots per hour.
With light breezes forward the beam, the mean of	78	hours sailing was		3·654
" moderate " " " "	227	"		4·555
" fresh " " " "	124	"		6·242
With light breezes abeam, the mean of	533	hours sailing was		4·209
" moderate " " "	476	"		5·622
" fresh " " "	316	"		6·000
With light breezes abaft the beam, the mean of	123	hours sailing was		3·683
" moderate " " " "	244	"		6·246
" fresh " " " "	183	"		8·000

By comparing the above performance under sail alone, with the performance under sail and steam for the same conditions of wind, &c., the value of the auxiliary steam will clearly appear as follows:

Under sail alone, with light breeze forward the beam, speed,	3·654	knots per hour.
" sail and steam, " " " "	4·511	"
Increase of speed due to steam, 23·45 per centum, or	0·857	"
Under sail alone, with light breeze abeam, speed,	4·209	"
" sail and steam, " " "	5 516	"
Increase of speed due to steam, 31·05 per centum, or	1·307	"
Under sail alone, with light breeze abaft the beam, speed,	3·683	"
" sail and steam, " " " "	6·157	"
Increase of speed due to steam, 67·18 per centum, or	2·474	"

The mean performance under sail alone, averaging the speed, with a light breeze forward the beam, abeam, and abaft the beam, is 3·849 knots per hour. The same mean for sail and steam, under the same con-

ditions of wind, is 5·395 knots per hour, or an increase of 40·17 per centum.

Of the whole amount of steaming done, 43 per centum was performed under steam alone, against a gentle breeze, and at a speed of 4·320 knots per hour. Against a moderately strong wind, under steam alone, the vessel could not make steerage way.

An observation of the large amount of slip given by the screw under all circumstances, clearly shows how much its efficiency had been sacrificed to obtaining a hoisting out arrangement. For this purpose, it was necessary to make the screw light, and to have it light, it must be of small diameter; the consequence of which was a propelling surface insufficient for the mass to be driven, and a resulting great loss by slip. Much of this, however, could have been obviated by giving the screw a considerably less pitch, and proportionably increased rotary velocity. The six blades on a screw of 9½ feet diameter are at least two too many, and the same projected area could be obtained with four blades, a reduced pitch, and same length on axis. The form of the screw seems to have been designed with a view to obtain the largest possible amount of friction surface on the water—the hollow braces of the hub, the drum, and unnecessary number of blades all largely swelling that formidable item, not to mention the direct resistance of their additional cutting edges, &c. The thickness of the hub proper is also out of proportion greater than the thickness of the blades. It is not probable that this type of screw will ever be imitated, as it entails many disadvantages, and no advantages, except the ease with which a spare blade could be fitted on, in the event of breaking one.

Performance of the U. S. Auxiliary Steamship Massachusetts, under steam alone.

Date.	Number of hours.	Speed of the vessel per hour in knots of 6082⅔ feet.	Course of the vessel.	WIND.		ENGINES.					Slip of the screw in per cents of its speed.	Consumption of Pennsylvania anthracite coal in pounds per hour.
				Direction.	Kind.	Steam press. in boil. per sq in abv atmos.	Number of double strokes of pist'n made per minute.	Steam cut off at from commencement of stroke of piston.	Proportion of throttle open.	Back pressure in condenser in pounds per square inch.		
April 11, '50,	24	4·688	—	—	Calm.	30	38·00	⅛	Wide.	2	37·46	510
" 12, "	18	3·722	NbyW	N. or ahead.	Mod. brez.	29	37·00	"	"	2	49·01*	534
June 20, "	14	4·250	E N E.	N. & E or "	Light "	22	30·00	"	"	2	30·69	460
" 25, "	14	4·696	N. W.	N. W. or "	" "	29	37·25	"	"	2	36·10	555
Aug. 12, "	16	5·391	—	Abeam.	Light airs.	24	36·92	"	"	2	26·00	615
Oct. 22, 23, and 24, "	50	4·600	N. W.	N. and W. or ahead.	Very light breeze.	25	40·00	"	"	2	41·71	626
Oct. 29, "	13	4·308	NNW.	"	Light airs.	25	39·25	"	"	2	44·36	576
June 5, 6, 7, and 8, '51,	81	5·444	—	—	" "	25	41·47	"	"	2	33·46	632
June 13, "	3	3·500	E,	E. S. E. or on bow.	Mod. breze	25	35·00	"	"	2	49·55	500
" 14, "	24	3·792	EbyN.	E. or ahead.	Light "	25	36·70	"	"	2	47·62	771
July 13,14,"	22	3·137	S. W.	S. W. or "	" "	22	35·52	"	"	2	55·23	566
" 16, 17, and 18 "	50	3·100	S. W.	S. & W. or "	" "	20	33·00	"	"	2	52·38	581
Aug. 27, "	6	5·500	—	—	Calm.	27	40·00	"	"	2	30·30	810
" 13, 52	10	3·400	S. W.	N&W.orabm.	Light brez	23	35·00	"	"	2	50·76	450
Sep. 2, 3, "	15	5·133	S.	W. or abeam.	Light airs.	28	39·20	"	"	2	33·63	685
" 12, 13, "	17	3·794	S. E.	S. or on bow.	" "	25	37·35	"	"	2	48·51	611
" 17, 18, "	31	3·758	—	On bow.	" "	29	39·22	"	"	2	47·41	686
Oct. 2, 3, "	11	3·773	S. W.	S.W.or ahead	Light brez	26	36·30	"	"	2	47·31	670
Means.		4·320				25	37·55	⅛	Wide.	2	41·68	621

Performance of the U. S. Auxiliary Screw Steamship Massachusetts, under steam assisted by sail.

WITH THE WIND FORWARD THE BEAM.

Date.	No. of consecutive hours.	Speed of the vessel per hour in knots of 6082⅔ feet.	Course of the vessel.	WIND. Direction.	WIND. Kind.	ENGINES. Steam press. in boil. per sq. in. abv. atmos.	ENGINES. No. of double strokes of piston made per minute.	ENGINES. Steam cut off at from commencement of stroke of piston.	ENGINES. Proportion of throttle open.	ENGINES. Back pressure in condenser in pounds per square inch.	Slip of the screw in per centums of its speed.	Consumption of Pennsylvania anthracite coal in pounds per hour.
April 6 & 7, 1850.	23	5·620	W.	S'd. & W'd.	Light brez.	31	39·53	½	Wide.	2	27·94	477
" 10, "	12	5·500	NbyW	N'd. & E'd.	"	35	40·00	"	"	2	30·29	550
June 18, "	4	5·625	—	—	"	25	38·00	"	"	2	24·96	410
August 5, "	12	5·667	S. S. E.	S. W.	"	24	38·00	"	"	2	24·62	520
May 1, 1851.	11	4·545	NbyE.	N'd. & W'd.	Mod. brez.	26	36·00	"	"	2	30·03	510
" 10, "	12	5·333	E.byS.	Southerly.	Light brez.	25	39·00	"	"	2	30·68	740
June 15 & 16, "	44	4·318	"	E. N. E.	"	25	36·75	"	"	2	40·44	738
July 18, 19, 20, and 21, "	65	3·170	W.	S'd. & W'd.	Mod. brez.	20	31·84	"	"	2	49·33	713
July 23 & 24, "	18	3·170	S. W.	"	"	19	30·91	"	"	2	48·01	738
August 3, "	20	5·450	W.	"	Fresh brez.	20	37·00	"	"	2	25·33	625
" 28 & 29, "	33	5·546	N. W.	N.	Light brez.	24	38·95	"	"	2	29·04	847
Dec. 29, 1852.	5	4·700	NbyW	N. N. E.	"	24	36·00	"	"	2	33·82	675
Means,		4·511				24	35·94	½	Wide.	2	36·38	679

WITH THE WIND ABEAM.

June 19, 1850.	22	6·227	—	—	Light brez.	25	37·60	½	Wide.	2	16·05	580
April 24, 1851.	13	4·615	N.	E. by S.	"	25	40·00	"	"	2	41·51	575
" 27, "	4	6·000	N. E.	N. N. W.	Mod. brez.	20	36·50	"	"	2	16·67	550
June 2, "	15	6·267	E. S. E.	N'd. & E'd.	Light brez.	25	42·40	"	"	2	25·07	704
" 3 & 4, "	48	5·834	"	North'ard.	"	25	38·90	"	"	2	23·98	724
" 11, "	6	5·750	"	N. E. by N.	"	25	40·00	"	"	2	27·13	550
" 17 & 18, "	37	5·730	E.¼ S.	South'ard.	"	25	41·35	"	"	2	29·75	685
" 23, "	10	6·000	N. E.	E. S. E.	"	25	41·00	"	"	2	25·80	867
Aug. 4 & 5, "	25	4·200	S. W.	N'd. & W'd.	"	20	33·00	"	"	2	35·47	738
Dec. 24, 1852.	9	4·000	S. E.	N. E.	"	25	36·00	"	"	2	43·67	562
Means,		5·516				24	38·76	½	Wide.	2	27·86	680

WITH THE WIND ABAFT THE BEAM.

Aug. 4, 1850.	17	5·530	S. S. E.	W.	Light brez.	24	38·20	½	Wide.	2	26·62	522
" 5, "	8	6·250	N. W.	S.	" "	25	40·00	"	"	2	29·79	566
April 25, 1851.	3	4·667	N.	S. S. E.	Mod breze.	25	39·00	"	"	2	39·76	600
" 26, "	8	5·690	NbyE.	S.	Light brez.	25	40·00	"	"	2	27·89	638
June 20, "	24	6·294	E.byS.	W.	" "	25	41·40	"	"	2	22·96	704
" 21 & 22, "	48	6·230	"	W.	" "	25	41·63	"	"	2	24·14	803
Dec. 2, 1852.	4	9·000	E.	S. W.	Freshwnd.	28	44·00	"	"	2	3·52	600
Means,		6·157				25	40·84	½	Wide.	2	23·58	701
Mean of 3 Means.		5·179				24	37·87	½	Wide.	2	30·68	684

*Wilkins's Steno-Telegraph, or the People's Penny Telegraph.**

Mr. J. W. Wilkins, of South-square, Gray's Inn, proposes to use only one wire for his telegraph, and to write the messages in a short-hand alphabet on strips of paper. He states that it is much more certain in its action than any other telegraph, and not liable to errors of any consequence. His principal improvements consist in a peculiar mode of insulating the wire, and in securing the full power of the electro-magnet, *in using the positive and negative currents* alternately, by which a great deal of time is saved in working the telegraph. The chief points upon which Mr.

* From Herapath's Journal, April, 1853.

Wilkins relies for the success of his plan and public support are certainty and rapidity of action, and simplicity and cheapness of construction. In addition to the advantages of cheapness of construction, he calculates on saving a considerable amount in the working expenses as compared with the expense of working other telegraphs, which will enable him to send messages at a much cheaper rate, and at the same time to realize ample returns on the capital invested. The saving in the working expenses depends entirely on the completeness of his mode of insulation. Owing to the present defective mode of insulation, he estimates that in general about nine-tenths of the power of the batteries is lost in that way, nearly the whole of which he expects to save on his plan. The patentee states that he is willing to undertake to lay down any length of line, including instruments, fittings up at stations, and patent right, for £20 per mile. The cost of materials for working the telegraph is stated to be 10s. per mile per annum; so that for an outlay of £2000, and £50 per mile per annum, a railway 100 miles in length may possess a telegraph, by the use of which the running of the trains on the line may be properly regulated, and numerous accidents prevented. It is obvious that the loss arising from one accident would be greater than the cost of construction and maintenance of such a telegraph in perpetuity, presuming it to be the business of the servants of the Company to attend to the telegraph.

Note on Inductive Electrical Machines, and on a Ready Means of Increasing their Effect. By M. Fizeau.*

The electrical machines which have been constructed of late years on the inductive principle are now well known; the constancy and regularity of their effects, as well as the facility of their employment, present marked advantages, which render these new machines preferable in some cases to those of the old construction.

Having undertaken some new experiments on the rapidity of the propagation of electricity, especially with the view of comparing in this respect electricity of tension with galvanic electricity, I found the employment of this apparatus very suitable for the purpose, but nevertheless that it would be useful to give greater power to the instrument, and especially to be able to increase the tension of the electricity furnished by it.

A very sensible increase of effect is obtained by employing a stronger pile to set the apparatus in action, and the electricity developed at the two poles of the machine acquires thus a very marked increase of tension. But this increase is accompanied by an inconvenience which deprives the instrument of its principal advantage, which consists in the regularity and the duration of its effects. One of the essential parts of the machine is M. de la Rive's vibratory contact-breaker. When the instrument is in action, very brilliant sparks are produced between the surfaces of the breaker, and although these surfaces may be formed of platinum, they are soon fused and destroyed when the current is rendered more intense; the vibrations becoming less constant in consequence, the production of electricity soon loses its regularity.

* From the Lond., Edinb., and Dublin Philosoph. Magazine, June, 1853.

The same inconvenience would no doubt be produced by giving the machine larger dimensions than those adopted by M. Ruhmkorff, for the force of the sparks which are produced at the point of vibration is due principally to the current induced in the conducting wire itself; and if the dimensions of the wires and the number of turns of the spire be increased, this current would of course become more intense and the sparks stronger.

But an attentive study of the peculiarities of the apparatus soon led to the discovery of an entirely different and very simple means of increasing the energy of the effects produced. Many experiments, which it would take too long to describe, tend to show that the current of induction which is produced in the inducting wire itself at the moment of the rupture of the circuit, exercises a considerable influence on the production of electricity in the induced wire which terminates the two poles of the machine. When this current is produced freely and takes a great development, the poles give but little electricity; but when, on the contrary, this current meets with obstacles, and only attains a slight development, the poles give much electricity, and the power of the machine becomes greater. Several arrangements served to prove this fact; I may mention the employment of metals more fusible than platinum on the surfaces of the breaker, and the union of the vibrating parts by fine wires of different lengths. This principle being admitted, it follows, that in order to increase the power of the machine, it is sufficient to oppose the development of the current which is produced in the inductor wire at the moment of the rupture of the circuit, and it is easy to see that this result must be obtained by acting upon the tension possessed by this current and rendering it weaker. In fact, when the machine is in action, the great light of the sparks which appear at the point of rupture, indicates that the current in question acquires a great development, and this is the case because the electricity possesses sufficient tension to pass with facility the space which separates the vibrating pieces: if the tension became weaker, the space to be passed presenting a constant resistance, the passage would not take place with the same facility, the sparks would be less brilliant, and the current would acquire a smaller development.

A very efficacious mode of diminishing the tension is to have recourse to the well-known properties of the Leyden jar, and other apparatus founded on the same principle. A condenser is formed of two leaves of tin in juxtaposition, but separated and insulated from one another by a layer of varnish, and each of the leaves put into communication with each extremity of the inductive wire; the points of attachment must be on both sides of the point of interruption when the sparks are produced. Then the two electricities, before arriving at the point of interruption, spread over the two surfaces of the tin, where they lose their tension to a great extent, in consequence of the mutual influence exercised across the isolating layer of varnish.

When the condenser presents a sufficient surface (5 or 6 square decimetres), the light is seen immediately to become weakened at the point of interruption, whilst the machine acquires a remarkable increase of energy; the poles then give stronger sparks and at a greater distance than before. The condenser may be conveniently placed in a horizontal posi-

tion, a little above the electro-magnet, and sustained by four glass supports. With this addition, which is very easily made, not only does the machine give more electricity, but it also continues longer in regular action, because the surfaces of the breaker are no longer exposed to the action of the very intense sparks which change them so rapidly.

An arrangement invented by M. Sinsteden, in which the principle of condensation has been employed to obtain stronger discharges with inductive machines, has only an apparent analogy with the method which I here indicate; the principle and the effects of the two methods being, in reality, very different. In fact, it is the electricity developed in the second wire, the inductive wire, which is modified by M. Sinsteden, so as to cause more brilliant sparks; but these stronger discharges are not accompanied by an augmentation of tension, which is, on the contrary, weakened. The employment of this method does not in any way injure the efficiency of that proposed by me, and they may both be employed together, where such a course is found advisable.

To furnish an idea of the increase of effect which I have obtained in my experiments, I will give the following observation. A galvanometer being placed in the circuit, the electricity produced by the machine was passed in rarefied air, when the beautiful phenomena of light recently studied by M. Quet were produced. When the machine acted under ordinary conditions, the needle of the galvanometer indicated a deviation of 8°. When the condenser was employed, the light produced acquired greater splendor, and the deviation of the needle reached 15°, the intensity of the current being consequently nearly double.—*Comptes Rendus, March* 7, 1853.

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*Purifying Apparatus of M. Bérard, for separating from Coal any foreign Substances which it may contain, such as Pyrites or Schist.**

The washing of coal, a system introduced into France within the last three or four years, is a branch of industry of the highest importance, permitting the use of coal which by its mixture with schist would not be otherwise employed. It may also be applied with advantage to certain coals, considered to be of good quality, but containing a quantity of ash, which diminishes the value. They are purified by this method in such a way as to allow of the manufacture of a coke from these coals, not containing more than three or four per cent. of ash. The Great Northern Railway of France has recognised the efficiency of this method, and a considerable part of the coke which it consumes is manufactured of washed coal; there result from its employment a marked economy of fuel, and a greater durability of the locomotives.

The expenses of washing, which are considerable by the ordinary method, are reduced to ten or twelve centimes (about a penny), per metrical ton† of fuel by M. Bérard's method. A very important desideratum may, therefore, be considered as obtained.

* From the Reports of the Juries of the Exhibition of the Works of Industry of all Nations, 1851. London.

† The metrical ton is equal to 1000 kilogrammes, or nearly an English ton, and contains 10 metrical quintals.—I. W.

The apparatus consists of three parts, viz:

1. An *elevator*, formed of an endless chain with buckets, which lifts from a trough or pit where the coals are placed a certain quantity, regulated by means of a valve.

2. A *separator*, into which the fuel is thrown by the elevator. This is composed of a long box, divided into compartments, and containing perforated plates, in stages, the size of the perforations being smaller and smaller by stages from the upper to the lower, so that by the shaking which this box undergoes, the coal is divided at once into four sizes. The finest powder falls to the bottom, and each of the three sizes of lumps being thrown out through openings in the sides of the box, into separate fixed sieves, called "bancs à lavage," which form the third part of the apparatus.

3. These "bancs à lavage" are long frames, measuring 9 feet 2 inches by 4 feet, of which the bottoms are pierced with holes, the diameter of which is smaller than that of the pieces of coal thrown into them. They are entirely filled with water, and divided in the interior into three parts. In one of these is a piston, which is worked up and down, and gives considerable motion to the water, which being communicated to the materials thrown on the bottom of the tank, these arrange themselves rapidly, in the order of their density, the heaviest being at the bottom. The pure coal alone comes to the surface, and by a current of water proceeding from a trough above, it is carried beyond the tank, and falls directly into the wagon, whence it is conveyed to its destination. The substances heavier than coal, such as schist or pyrites, are deposited on the perforated bottom of the tank, which has a slight inclination towards a trap, and thus constantly advance towards an exit. By a peculiar arrangement, the rubbish is thus made to carry itself into a compartment prepared inside of the tank, whence it is removed by the mere opening of a valve.

It will be seen from this description, that the work is continuous throughout, and requires no manual assistance. According to the declaration of M. Bérard, the quantity of coal that can be cleaned in an hour by a machine, the total cost of which would be 10,000 francs, (£400,) is ten to twelve metrical tons. The working of such a machine would not require more than about 2000 gallons of water per day (8 to 10 cubic metres).

The various specimens exhibited are as follows:

1. Coals classed in four sizes, and the foreign matters that have been separated from them.

2. Two specimens of coke; one made from coal as it comes from the mine, and the other from "washed coal." The first contains 26 per cent. of ash, the second only 2½ per cent.

3. A drawing of the apparatus.

The specimens are from an establishment founded by M. Bérard, at Molenbeck St. Jean, near Brussels.

M. Bérard states that his apparatus has been adopted by the mining companies of the Loire, Creuzot, Epinac, &c., in France, and that at the present time there is one being erected at Newcastle.

*Callen & Ripley's New Multiplying Rotative Power.**

A new multiplying rotative power has just been patented by Messrs. Callen and Ripley, of Parliament street, Westminster, by which the speed of any shaft, or other revolving body, can be increased or diminished without the use of cog-wheels, bands, or other gearing, hitherto in use. The loss of power, with the noise and danger attendant upon the use of cog-wheels, bands, &c., has been long and deeply felt, and the substitution of a safer, more efficient, and less costly mechanism, has engaged the attention of scientific men for many years without success, until this great desideratum has been at length attained, by the application of a circular grooved disk to the ordinary crank, thus producing a multiplier combining the most beautiful simplicity of construction with enormous strength and durability, at one-sixth of the present cost. The disk and crank transmit the motion with a perfectly uniform speed and power, without the least noise, and require only one-half of the space occupied by the present gearing; it is, therefore, not only of vast general utility, but pre-eminently applicable to steam-vessels, where the continual noise and clatter produced by cog-wheels has always been found so objectionable, while the small space required admits of its being easily fitted below the water-line, and clear of shot, which will be of great advantage in its application to our screw navy. Another, and not the least of the advantages of this invention, is, that not the slightest chance of accident to life or limb (so prevalent with cog-wheels and bands) can possibly occur, a boon which the manufacturing million will not be slow to appreciate. Taking into consideration the magnitude of the advantages possessed by this simple, yet important invention, it is not surprising to find that it should continue to engross the attention of the engineering and scientific world; nor is it, perhaps, too much to add, that a very short time must witness its universal adoption.

J. L. Stevens' Patent Smokeless Furnace.†

As "the time produces the man" for its particular emergency, so does it often elicit "the means" for attaining an immediately desired object, and just at the moment when the necessity for an efficient invention to prevent the formation of smoke, in all its frightfully increasing density and profusion, has become manifest, we have both the man and the means before us. The smokeless furnace invented and patented by Mr. John Lee Stevens, with whose scientific ability and persevering industry the readers of the *Mining Journal* cannot be unacquainted, appears to us to possess every requirement for the purposes for which it is intended; its leading points being novelty of conception and combination, united with extreme simplicity, cheapness of construction, and durability, unendangered by any movable parts; added to which, the labor of the fireman is absolutely simplified and lessened, instead of the contrary. We are enabled, with the assistance of the following diagrams, to give a tolerably

* From the London Mining Journal, No. 921.

† From the London Mining Journal, No. 921–923.

accurate description of this important invention—important to many, as effecting very considerable economy of fuel, and to all as the subduer of that modern enormity, universally known as the "smoke nuisance."

FIG. 1.

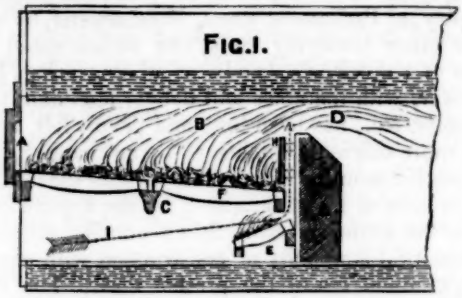
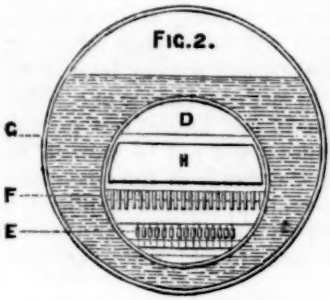


Fig. 1 is a longitudinal, and fig. 2 a transverse section, of a patent smokeless furnace, fitted in a Cornish boiler, conformably with the new system, which is alike applicable to every description of boiler, old or new.

FIG. 2.



A, doorway to the furnace, B, C; D, commencement of flue; E, the first, and F, the second, set of fire-bars; G, the bridge; H, calorific plate; I, the current of air. It will be seen that the invention consists in the combination of two sets of fixed fire-bars, the first of which is chiefly fed by the scoria and cinders voided from the second or upper set of fire-bars, with a calorific plate, the face of which may be protected by a few fire-bricks; by which arrangement the current of air entering at the lower part of the furnace passes through two strata of fire, and thence between the calorific plate and the bridge, and is thus so intensely heated as continuously to produce the entire combustion of the gaseous products of the fuel, and to prevent the ordinary formation of smoke. It is, in effect, a double furnace, confined to the limits of, and economically applicable to, any common description of furnace; has all the advantages of a hot-blast without the cost of any pneumatic apparatus; is so contrived as uniformly to distribute and keep up the requisite heat in boilers of whatever form; and whilst most effectually preventing the annoyance of smoke, and the usual deposit of soot in the flues, it causes an average saving of at least 20 per cent. in the quantity of fuel consumed, and also admits the substitution of the cheapest for that of a dearer quality, and of small instead of large coals, as further means of reducing the expense of consumption.

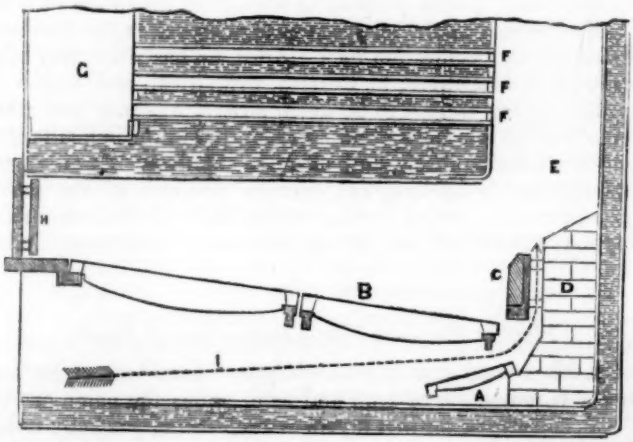
These claims to preferential consideration are now unquestionably sustained by the strong and concurrent testimonials in favour of the invention that have been submitted to us, and which place the saving in the cost of fuel a little in excess of the inventor's calculation, being in various proportions that range from 20 to 26 per cent.; and the highly respecta-

ble parties from whom they emanate agree in declaring that the smoke, visible only when the "hot blast" is suspended by the door being opened for a renewal of coals to the furnace, is reduced to the lowest possible minimum in quantity, thinness, and duration; and is, indeed, so light, as to be described as "a little smoky vapor." We may, therefore, hope very soon to see the last of the dense smoke, pouring out in thick and murky currents over and through the metropolis, from shafts and funnels innumerable, and hitherto indomitable. Nor will the benefits thus conferred on commerce specially, and on society universally, be confined to London—throughout the United Kingdom they will be shared, and, we doubt not, duly appreciated.

Mr. Lee Stevens has already succeeded with his invention, modified to suit the various forms of boilers respectively used by Messrs. Ward and Co., Grand Junction Wharf, and Mr. William Batley, engineer, Bridge-street Works, Northampton; Messrs. Samuel and William Standing, engineers, Osborn-street, Whitechapel; Messrs. Welch and Margetson, Cheapside; Messrs. Herring, Brothers, and Co., Aldersgate street; Messrs. Keens and Welch, Garlick-hill; the General Screw Steam Company's ship, the *Earl of Auckland*, &c.; and we understand is daily adding to the number, both in town and country.

The following diagram is a longitudinal section of the furnaces fitted to the boilers of the *Earl of Auckland*, Captain Wintle, belonging to the General Screw Steam Shipping Company, running between London and Rotterdam.

Fig. 3.



A first, and B second set of fire-bars; C, calorific plate, faced with fire-bricks; D, bridge; E, furnace-flue; F, boiler tubes; G, funnel-flue; H, furnace-door; and I, direction of current of air.

It will be obvious to any practical man that, in marine boilers constructed like those for the Royal Navy, which slope upwards from the ash-pit towards the furnace-flue, and so take from the furnace space the angle occupied by the brick bridge D, the invention will be adapted accordingly; the sloped water space forming the bridge.

On board the *Earl of Auckland*, after the most careful comparison with previous consumption, the ascertained saving in the expenditure for three consecutive voyages, out and home, with Welsh coals, is found to be more than 10 per cent.; and no doubt exists that, when the average has been taken for the same number of voyages with Hartley, or other similarly bituminous steam-coals, the economy of fuel will reach 20 per cent., independently of the comfort and advantages arising from the entire absence of dense smoke. A maritime friend of ours, who has witnessed the operation of the invention on board that steamer, besides corroborating the more material points in its favor, says that, as regards the subversion of smoke, "It is like striking the broad, black, piratical pennant, and running up a strip of thin brown bunting to signalize, for a moment, the putting on of fresh fuel." And to show of how much consequence (to some of them almost vital) the saving of fuel must be to our principal steam navigation companies, five of them could be named whose aggregate reduction, at 10 per cent. only, (that is, supposing nothing but Welsh coals were used) would amount to very nearly 100,000*l.* per. annum; and certainly to 150,000*l.* a year, if patent fuel or north country coals were consumed. What the saving will be on *land*, throughout the United Kingdom, computed at a fair average of 20 per cent., we leave to some ingenious reader to calculate.

Under these circumstances, we think the inventor, Mr. John Lee Stevens, has established the utility of his Patent Smokeless Furnace in a surprisingly short time, as well as in the most satisfactory manner. Independently of its preliminary use in Cornish boilers at Northampton, since October last, for the purpose of testing an invention on a working scale, and obtaining all the advantages of practical experience before the completion of his specification on 1st April, he has since then adapted it in London, and elsewhere, to Cornish, cylindrical, and wagon boilers, for engines varying from 4 to 60 horse power, on land; and with equal success to tubular marine boilers. In fact, the intrinsic merits of the invention—the simple, cheap, and effective supply of hot air for the purpose of thoroughly burning the gaseous products of the coal—have established for it a practical reputation that bids fair to ensure its universal adoption; wherefore it has our best wishes and disinterested advocacy.

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*Plumbic Zinc—A New Combination of Metals.**

Messrs. Morewood and Rogers, of Upper Thames-street, have recently patented a combination of lead and zinc, under the name of "plumbic zinc." It consists of distinct layers of each metal, perfectly united in a peculiar process of manufacture—one side thus presenting a surface of pure lead, the other pure zinc, combining the stiffness of the latter with the durability of the former. A sheet of metal is thus produced, which proves as hard and durable as one of lead several times its thickness and weight; while in peculiar situations the zinc is laid undermost, and is thus protected from atmospheric action, or the effect of acid vapors or liquors, by the preservative power of the lead. For every description of roofing,

*From the London Mining Journal, No. 921.

hips and ridges, gutters, pipes, cisterns, sinks, &c., this metal will most probably be found highly advantageous. For covering terraces, balconies, stairs, and passages, it will be found similar to lead under the feet; while the stiff lining of zinc will prevent it from treading out of shape. For chimney tops, cowls, &c., the lead is placed inside, which is indestructible from the sulphurous acids and vapors usually contained in smoke. For coal-boxes, baths, pails, and many other domestic utensils, it will also be found highly useful. Japan will adhere to it as well as to iron plate. It will solder as effectually as tin plate, and works softer and with greater facility than sheet zinc alone. It is also recommended for lining tunnels, sheathing ships, &c.; and no doubt numerous other uses will yet be found for it. We understand the Government authorities at Melbourne have contracted for a given period to secure the entire quantity which may be exported to Victoria for flooring and roofing many of the public and private buildings erecting in that city.

Process for Photographic Engraving. By H. F. Talbot.*

I beg to inform you that I have recently had the good fortune to advance another step in the path of photographic discovery; and as I am in hopes that what I have accomplished will prove of great practical utility, I have drawn up the following brief account of it:

Attempts have been made by several ingenious persons, especially on the Continent, to complete the daguerreotype process by engraving the plate impressed with the photographic image; that is to say, by causing it to engrave itself, by using chemical means only, and without requiring it to be touched in any way by the hand of an artist or engraver. Nor have these attempts been unsuccessful in themselves; on the contrary, specimens have been at various times brought over from Paris, quite sufficient to show that the thing is feasible. But the practical difficulties of execution have been such as to limit the utility of the invention; and I understand that the plates have been found to wear out after affording but a small number of impressions.

I have been so fortunate, however, as to discover a method, which I believe to be entirely new, of solving this interesting problem, which already in my hands succeeds with a reasonable degree of certainty for a large class of photographic objects, and which will doubtless be soon and greatly improved by other experimenters. I am now engaged in drawing up a full account of the process, which will be ready for publication in a few weeks; but in the mean time I trust you will permit me to sketch a general outline of the subject.

I will begin by referring to the labors of those who have preceded me in this line of research. The first person who turned his attention to this subject was Dr. Donné, of Paris, about the year 1840, as appears from the *Comptes Rendus* of the Academy of Sciences. I believe, however, that his attempts were not crowned with much success, and were soon discontinued. I have not seen any of the specimens which he executed. Dr. Berres, of Vienna, was, I think, the next to take up the subject. The

* From the London Athenæum, April, 1853.

specimens of his engravings which I have seen are of small size; they exhibit considerable sharpness in the outlines, but no half-tints or gradations of shade, the want of which produces a harsh effect. I understand that Dr. Berres' secret has never been disclosed. After him, the subject was resumed by M. Fizeau, of Paris, with considerable success. Some specimens which I have seen, stated to have been made by him, are beautifully distinct. But, notwithstanding that his process was taken up with a view to its improvement by more than one eminent photographer in London, I believe that its use has been discontinued, owing to the great uncertainties which attended it, and wearied the patience of the experimenters. There may perhaps have been some other experiments published, but the above mentioned are the chief processes of which I have seen specimens, or met with any published account. Some months ago, I resolved to take up this curious problem, as offering an interesting field of research and delicate experiment.

Abandoning the methods hitherto employed, which had not been found in practice sufficiently successful, I entered into a new path, which shortly gave me hopes that I was proceeding in the right direction. But as I advanced, difficulties appeared to multiply; and I found that on various occasions the results were most anomalous and contrary to all expectation. For instance, when I had prepared every thing, as I thought, to produce a positive etching of an object, the result was a negative etching of it. At other times half the plate was etched positively and the other half negatively, and of course such a result remained useless for any practical purpose. I here employ the term "*positive etching*," which I believe has not been used before, to imply an etching of such a kind that the impressions struck off from it represent the objects positively, or as they are in nature: and of course I employ the term "*negative etching*" in the opposite sense. The anomalous results which I at first obtained obliged me to submit to a careful investigation the photographic properties and the chemical reactions of a considerable number of substances, until at length the principal facts observed were satisfactorily explained, and the nature of the disturbing causes being known, the process was brought under control. And it was found that by comparatively slight changes in the mode of manipulating, either a positive or a negative etching could be produced at pleasure. But, of the two, the positive was the more perfect, and appeared also to be much more manageable than the other; which principal point being ascertained, I thenceforward devoted my attention chiefly to the perfecting of the positive process. I have now to mention to what point I have as yet succeeded in improving it. The objects most easily and successfully engraved are, those which can be placed in contact with the metallic plate, such as the leaf of a fern, the light feathery flowers of a grass, a piece of lace, &c., &c. In such cases the engraving is precisely like the object; so that it would almost seem to any one, before the process was explained to him, as if the shadow of the object had itself corroded the metal, so true is the engraving to the object. If a veil of black crape is laid upon the metal plate, every thread of it is engraved with wonderful precision and distinctness; and if two thicknesses of the crape are placed upon the metal, obliquely to each other, still the resulting engraving offers no confusion, but with the help

of a lens the lines belonging to each of the folds can be distinguished from those of the other.

Objects which cast a broad and uniform shadow, as, for instance, the opaque leaf of a fern or other plant, produce an etching, which, when printed off, delineates the original in a pleasing but unusual manner, something between an aquatint engraving and an indian ink drawing. But I have no doubt that a great variety of other effects will be found to be obtainable from the process. When the object to be copied is a photograph on paper, the process offers some difficulties which have not yet been entirely surmounted. Not that the engravings thus obtained are deficient in accuracy, for they follow the original with considerable minuteness of detail; but because the gradations of shadow and the depth of the etching upon the plate are found not to follow the same law as they do upon the original photograph. There is a much greater difference on the plate than exists in the original; the shadows are too deep and the lights are too strong. I am not without hope, however, that means of avoiding this may be discovered when the process shall be better understood. Some change or other in the manipulation may possibly be found to abolish this law of variation in the intensity of the shadows, and to substitute another more in conformity with nature.

I must not pass over a leading feature in my new process. It is this: I find that the *size* of the plate to be engraved makes no difference in the result of the process, except that it necessitates, of course, a greater degree of carefulness in the operator. Consequently, whatever degree of accuracy is obtainable on small plates is likewise obtainable on large ones; and this is a fact of considerable importance. For, the advantage of this new mode of engraving, the quantity of objects and details represented increases in proportion to the area of the picture, while the error or inaccuracy which affects each individual point is of constant magnitude. In large plates minute deviations from the outlines of the original, even if they exist, are of little consequence. They are merged and disappear in the general effect.

Lacock Abbey, April 4.

I now proceed to give you an account of my newly invented method of making photographic engravings upon steel. Of course, I have no need to observe that the art is at present in its infancy, but I have great hopes that it will very soon be considerably improved in all its details.

The first thing to be done is, to select a good steel plate, and to immerse it for a minute or two in a vessel containing vinegar mixed with a little sulphuric acid. The object of this is to diminish the too great polish of the surface; for otherwise the photographic preparation would not adhere well to the surface of the steel, but would peel off. The plate is then to be well washed and dried. Then, take some isinglass and dissolve it in hot water. The solution should be strong enough to coagulate when cold into a firm jelly. This solution of isinglass or gelatine should be strained while hot through a linen cloth to purify it. To this must be added about half as much of a saturated solution of bichromate of potash in water, and they should be well stirred together. When cold, this mixture coagulates into a jelly, which has very much the appearance

of orange jelly. The method of using it is, to liquify it by gentle heat, and to pour a quantity upon the centre of the steel plate. Then take a glass rod, hold it horizontally, and spread the liquid uniformly over the plate. Then incline the plate, and pour off the superfluous gelatine. Let the steel plate be placed upon a stand, and kept quite horizontal, that the liquid may not run to one side of the plate. Then place a spirit lamp beneath the plate, and warm it gently till the gelatine is quite dried up. When dry, the film of gelatine ought to be bright yellow and very uniform. If clouded bands appear upon the surface it is a sign that there is too little gelatine in proportion to the bichromate, which must therefore be corrected. The steel plate, now coated with gelatine, is ready to receive a photographic image of any object. First, let us suppose the object is one capable of being applied closely to the surface of the plate; for instance, et it be a piece of black lace or the leaf of a plant. Place the object upon the plate in a photographic copying frame, and screw them into close contact. Place this frame in the direct light of the sun for a short time, varying from half a minute to five minutes. Let it then be removed and the plate taken out, and it will be found impressed with a yellow image of the object upon a ground of a brown color, as might be expected from the well known photographic property of the bichromate. The plate is then to be placed in a vessel of cold water for a minute or two, which dissolves out all the bichromate and most of the gelatine also from the photographic image; *i. e.* from those parts of the plate which have not been exposed to the sun, being protected by the object; while, on the contrary, it dissolves little or none of the gelatine film which has been fully exposed to the sun's rays. The consequence of which is, that instead of a yellow image we have now a white one, but still upon a ground of brown. The plate is then removed from the water into a vessel of alcohol for a minute, and it is then taken out and placed upright on its edge in a warm place, where in the course of a few minutes it becomes entirely dried. This terminates the photographic part of the operation. If the plate is carefully examined while in this state, it appears coated with gelatine of a yellowish brown color, and impressed with a white photographic image, which is often eminently beautiful, owing to the circumstance of its being raised above the level of the plate by the action of the water. Thus, for instance, the image of a piece of black lace looks like a real piece of very delicate white lace of similar pattern, closely adhering to, but plainly raised above, the brown and polished surface of the plate, which serves to display it very beautifully. At other times the white image of an object offers a varying display of light when examined by the light of a single candle, which indicates a peculiar molecular arrangement in the particles of gelatine. These photographic images are often so beautiful that the operator feels almost reluctant to destroy them by continuing the process for engraving the plate.

In order to explain how such an engraving is possible, it is, in the first place, to be observed that the photographic image differs from the rest of the plate not only in color, but, what is of much more importance, in the thickness of the film of gelatine which covers it. The coating of gelatine on the rest of the plate is, comparatively speaking, a thick one, but that

which originally covered the image has been mostly removed by the action of the water, a small portion, however, almost always remaining. It therefore naturally happens that when an etching liquid is poured on to the plate, it first penetrates through the thin gelatine covering the image, and etches the steel plate beneath. But the next moment it penetrates likewise through the thicker coating of gelatine, and thus spoils the result by etching the whole of the plate. Nitric acid, for instance, does this, and therefore cannot be employed for the purpose. Since the other chemical liquids which are capable of etching steel have a certain analogy to nitric acid in their corrosive properties, they also for the most part are found to fail in the same manner.

This was a difficulty. But after some researches I found a liquid which etches steel perfectly well, and at the same time is free from the inconvenient property of penetrating the gelatine film. This liquid is the bichloride of platina. In order, however, to use it successfully, it must be mixed with a certain quantity of water, neither more nor less, (I mean to any material extent,) otherwise its action becomes irregular. The best way is, to make a perfectly saturated solution, and then to add to it one-fourth of its bulk of water. Then correcting this by a few trials, a solution of proper strength is finally obtained. Supposing, then, that we have prepared such a solution, the operation of etching the plate is performed as follows:—The plate is laid on a table, and a small quantity of the bichloride being poured upon it, it is to be rapidly diffused and spread over the whole plate with a camel-hair brush. Not much liquid is poured on, because its opacity would prevent the operator from distinguishing the effect produced by it on the metal. For this reason, it is hardly necessary to make a wall of wax round the plate; that is, if the portions to be etched are confined to the central part of the plate, and do not approach very near to the edge. The effect of the liquid upon the plate is not at first visible, since it disengages no gas; but after the lapse of a minute or two, the white photographic image begins to darken, and soon becomes black in every part. When this change is complete, the image often looks very beautiful, though quite altered from what it was before. The operator should carefully watch the image until he thinks that it is finished, or not likely to be further improved or developed by continuing the process any longer. He then inclines the plate gently, and pours off the liquid by one corner of the plate. The plate is then dried with blotting paper, and then a stream of salt water, which is better than fresh water for this purpose, is poured over the plate, which removes all traces of the etching liquid. The plate is then rubbed with a wet sponge or linen cloth, which in a short time detaches and removes the film of gelatine, and discloses the etching that has been effected. When the object is not of a nature to be applied directly to the surface of the plate, the most obvious method of proceeding is, of course, to place the prepared plate in the focus of a camera, and to direct the camera to the object. But in consequence of the low degree of sensitiveness of bichromate of potash, this would take, generally speaking, too long a time to accomplish. The better way in practice, therefore, is, to take a negative photograph of the object on paper with a camera, and from this to obtain a positive copy either on glass or paper, which should be very uniform in

texture, and moderately transparent. Then this positive copy is placed on the plate in a photographic copying frame, and being placed for a few minutes in the sun, it impresses the plate with a photographic image; which image, etched as above described, and printed off upon paper, will finally give a positive representation of the object. If the object depicted upon the plate by the sun's rays is broad and uniform, for instance, the opaque leaf of a plant, then, of course, the etching is uniform also. When this is printed off, it produces an effect which is not always satisfactory. I will therefore now explain a modification of the process which destroys this uniformity, and which in many cases produces a great improvement in the general effect.

For this purpose I must remark, in the first place, that if a piece of black gauze or crape is the object selected for representation, it produces an engraving of itself which is marvellously accurate. But when two folds of the gauze are laid across each other obliquely, then the resulting engraving requires a lens in order to separate from each other and distinguish clearly the lines belonging to the two portions of the gauze. Now, if this engraving is printed off, the result offers to an eye at a moderate distance the appearance of an uniform shading. Now, I avail myself of this circumstance, to modify my original process as follows: suppose the object to be the opaque leaf of a plant, of irregular outline; first, I cover the prepared plate with two oblique folds of black crape or gauze, and place it in the sunshine for two or three minutes. The effect of this is, to cover the plate with a complicated image of lines passing in all directions. Then the leaf is substituted for the crape, and the plate is replaced in the sunshine for two or three minutes more. The leaf being then removed from the plate, it will be seen that the sun has obliterated all the lines that were visible on the parts of the plate exterior to the leaf, converting all those parts to a uniform brown. But the image of the leaf itself is still covered with a network of innumerable lines. Now, let this be etched in the way already described, and let the resulting etching be printed off. The result is an engraving of the leaf, which when beheld by the eye at a certain distance appears uniformly shaded, but when examined closely is found to be covered with lines very much resembling those produced by an engraver's tool, so much so that even a practical engraver would probably be deceived by the appearance. This crape arrangement I call a *photographic veil:* and as I think it likely that the idea will prove useful, I will make a few more remarks upon it. It is clear that an arrangement composed of two thicknesses of ordinary crape or gauze is but a rude attempt at a photographic veil. To realize the practical utility that may result from the idea, supposing it to be borne out by further experience, it would be proper to fabricate a much finer material, and to employ five or six thickesses of it, or else to cover a sheet of glass in any convenient manner with an innumerable quantity of fine lines, or else with dots and specks, which must be opaque and distinct from each other. The result of practically employing such a method, supposing always that it answers in practice, as I think it probably will, would be an etching apparently uniform, but really consisting of separate small portions, in consequence of which it would hold the ink much better, and other obvious advantages would also be obtained. Another

mode of accomplishing the same object is to cover the plate originally with an aquatint ground. But then a fresh one would be required for every plate, whereas a single *veil* would serve for any number of plates in succession. Experience alone can decide between these different methods. When the etching is finished, the plate should be very soon coated with wax to protect it. A few hours' exposure to the atmospheric air rusts and destroys the etchings when newly made, although it does not do so afterwards. The oxidation only attacks the lines of the etching, the rest of the plate sustaining no injury, if the air is tolerably dry.

Having thus described the method of producing the photographic etchings, it would, I think, extend this letter to too great a length were I to add any remarks upon the theory of the process, which will better be deferred to another opportunity.

Lacock Abbey, April 25.

On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain. By MM. Ebelmen and Salvetat.*

(Continued from page 36.)

2. *Blacks.*

The authors have analyzed four different specimens of blacks, namely, the black called *Si-fen-liao*, in the collection of the Musée Céramique, and the shining, dull, and bright blacks of the collection brought from Canton by M. Itier. The results are as follows:—

	Fen-liao. I.	Ou-kin. II.	Liang-he. III.	Tse-he. IV.
Loss by heat,	14·20	25·60	3·20	16.60
Silica, . .	2·00	1·98	50·70	6·00
Oxide of lead,	69.14	59·58	25·00	traces
Oxide of copper,	4·60	8·40	5·80	5·40
Oxide of iron,	3·00			
Oxide of manganese,	7·00	1·70	10·02	70·00
Oxide of cobalt,				
Alumina, .	0·24	0·62	0·52	0·40
Lime and Magnesia,	0·60	1·43	1·67	1·20
Alkali, . .	0·00	0·69	3·09	0·40

I. *Si-fen-liao.*—This is a brown powder with a greenish tinge. It effervesces strongly when treated with dilute nitric acid, and the solution presents all the characters of nitrate of lead. Before the blowpipe and with reagents it behaves like a mixture of white lead and an oxide of manganese containing cobalt.

II. *Ou-kin*, metallic black or raven-black, (ticketed *noir mat*).—This is in elongated fragments of the form of small sticks, or in irregularly rounded masses.

With reagents it behaves like *si-fen-liao*. It differs from that color in being made up into masses with size; but when this is removed, both colors consist of 5 parts of white lead and 1 part of the mineral called *thsing-hoa-liao*. It follows also from the analyses that this mineral must be of very variable composition.

In both these blacks the silica is only introduced by the gangue of the

* From the London Chemical Gazette, No. 243.

manganesian mineral, and this circumstance occurs also in other colors. It explains certain effects which may be remarked in the decoration of some Chinese porcelain, which are adorned with dull black or red ornaments, forming an agreeable contrast with the other well-glazed ornaments.

Laid on porcelain and exposed to the heat of the muffle-furnace, the two preceding colors only adhered in the thin parts. Where they were thicker, the oxide of lead was absorbed by the oxides, which in the absence of silica were incapable of forming a vitreous varnish. The thin portions, on the contrary, shone, because in these parts the small quantity of silica was sufficient to transform the oxide into silicate of lead.

III. *Liang-he*, shining black (ticketed *noir luisant*).—This is a brown powder, which must have been formed from a previously fused mass. With nitric acid it effervesced slightly, and the solution contained lead. Before the blowpipe it gave the reaction of cobalt. Oxide of manganese exists in it in smaller quantity than in the preceding colors.

IV. *Tse-he*, porcelain-black (ticketed *noir clair*).—This consists of dark greenish fragments, which are crushed with difficulty, and when burnt emit a distinct odor of burnt glue. It appears to be a mixture of *thsing-hoa-liao* with a size formed from bullocks' hides (*yeou-p'hy-kao*), which, according to Father Ly, is the solvent employed by the Chinese to render their colors fit for use. The silica, which forms 6 per cent. of the mass, is much contaminated with alumina; it is the gangue of the cobaltiferous mineral. The authors have tried this black as a blue under glazing; it gave blue designs perfectly resembling those which occur on many specimens of Chinese porcelain. As, however, the temperature of the furnaces at Sèvres is greater than that of the Chinese furnaces, the portions on which the oxides were thickly laid became inflated during the baking.

3. *Blues.*

The collection sent by Father Ly contains four different specimens of blue,—two in the rough state, and two completely prepared for painting. From the analyses it appears, that, in conformity with the statement made by Father Ly, there is no difference between the rough and prepared colors.

Seng-khouang-thsei, or rough blue of the first quality, requiring no addition of *yuen-feng;* it must be pounded (Ly).

This color is in well-fused, brilliant, transparent masses, of a fine sky-blue. It is frequently paler and opake in the interior of the masses; this appears to arise from imperfect fusion. When powdered, it is of a paler but pure blue color; and if treated immediately after this operation with dilute nitric acid, it does not effervesce.

Si-khouang-thsei, or prepared blue of first quality (Ly).—This is a powder which effervesces slightly with nitric acid from the presence of a little carbonate of lead. With acid it behaves like the preceding, resisting their action very well. Muriatic and nitro-muriatic acids discolor it completely after long boiling.

Sing-ting-thsei, rough blue of second quality, without need of *yuen-feng* (Ly).—This consists of perfectly transparant blue fragments. When

triturated, it furnishes a powder of a paler and more violet color than that given by the *khouang-thsei*. With acids it behaves like that color.

Si-ting-thsei, or prepared blue of second quality (Ly).—This is the powder furnished by pounding the preceding. It effervesces slightly with dilute nitric acid.

The following are the results of our analyses of these four colors:—

	Khouang-thsei.		Ting-thsei.	
	Seng.	Si.	Seng.	Si.
Loss by heat,	0·00	3·80	0·65	2·40
Silica, . .	48·21	46·40	38·81	37·20
Oxide of lead,	32·84	30·89	44·14	42·18
Oxide of cobalt,	1·50	1·60	0·68	0·50
Oxide of iron,	1·63	1·50	1·03	1·06
Lime, .	0·97	0·85	0·83	0·64
Magnesia,	trace	trace	trace	trace
Potash and soda,	13·78	13·20	11·10	13·39
Oxide of copper,	1·00	0·96	0·50	0·15
Oxide of manganese,	0·50	0·62	1·00	1·00
Alumina, . .	0·06	0·15	0·50	0·50

In the second and fourth analyses, the loss includes the water and carbonic acid of the carbonate of lead formed by exposure to the atmosphere. The difference in the proportions of the oxides of cobalt and manganese explains the difference in the tint of these two blues; the second is paler and more violet than the other.

M. Itier brought the two following blues from Canton:

P'ao-lan, precious blue (ticketed *bleu foncé*).—This is a powder containing fragments. It resists the action of acids better than the preceding blues, but effervesces slightly with them. Under water it is seen to consist of two powders of different blues.

Tsing-fen, blue powder (ticketed *bleu de ciel foncé*).—This is a paler powder than the preceding. It effervesces slightly, and resists the action of acids rather less than the *p'ao-lan*.

The analyses of these two colors gave—

	P'ao-lan.	Tsing-fen.
Loss by heat, . .	3·00	1·40
Silica with traces of stannic acid,	60·80	47·20
Oxide of lead, . . .	18·76	38·90
Oxide of cobalt, . .	1·62	0·50
Oxide of iron, . . .	1·50	1·00
Lime, . . .	1·08	0·64
Magnesia, . . .	trace	trace
Potash and soda, . .	0·19	9·34
Oxide of copper, . . .	1·00	trace
Oxide of manganese, . .	1·50	0·84
Alumina, . . .	0·55	0·18

Thus all Chinese blues consist of a plumbo-alkaline glass colored with oxide of cobalt. The only difference between them lies in their various degrees of fusibility.

4. *Greens.*

All the greens employed in the decoration of porcelain in China are colored by oxide of copper, sometimes pure, sometimes rendered yellowish by the addition of prepared yellow, or bluish by the addition of white or of a harder flux.

The authors have only examined the rough colors, as, according to the

statements of Father Ly, the prepared colors would only differ from the rough ones in being triturated, or sometimes mixed with white lead.

Fei-thsei, rough green of first quality, to a pound of which 12 oz. of *yuen-feng* are added (Ly).

This is of a turquois-blue color; its powder is pale sea-green. Father Ly says, that when this color is of a coarse quality, it is mixed with *sy-chy-mo*. The authors think that it must be in a similar case that the large addition of *yuen-feng* mentioned above is necessary, as this addition does not appear to be required with the specimen in the Musée Céramique.

This color is produced by the fusion of white with the following green. In M. Itier's collection there are two greens of the same shade,—one which M. Itier calls light blue (*bleu clair*), and another which he names sea-green (*vert d'eau*).

Tcha-lan, light blue (ticketed *bleu clair*).—This is a fine powder of a pale turquois-blue. By immersion in water, two different powders are perceived in it,—one blue, the other white or grayish. The latter lowers the strength of the blue. The mixture effervesces slightly with nitric acid.

Chan-lou, mountain green (ticketed *vert d'eau*).—This is a homogeneous powder, very similar to the *fei-thsei* of Father Ly's collection. The color is derived from deutoxide of copper.

The analysis of these three greens gave the following results:—

	Fei-thsei.	Tcha-lan.	Chan-lou.
Loss by heat,	0·50	2·40	1·00
Silica with traces of stannic acid,	37·50	41·50	42·44
Oxide of lead,	44·13	43.40	43·40
Oxide of copper,	3·00	2·40	3·41
Alumina and oxide of iron,	trace	0·86	1·26
Lime,	0·25	2·11	2·00
Arsenic acid,	4·00	7 33	6·49
Potash and soda,	10·00		

The presence of an opake white is not necessary for the production of this tint with oxide of copper; the addition of a silico-alkaline flux, containing equal parts of sand and oxide of lead, is sufficient to produce this tint from the *chang-lou* green, which is now to be described. It is therefore possible that there is no white in M. Itier's "pale-blue," and that the grayish particles are simply a plumbo-alkaline flux.

Seng-chang-lou, green of the fourth quality, to (a pound of?) which 5 oz. of *yuen-feng* are added (Ly).

This occurs in masses of a sap-green color; its coloring principle is oxide of copper; it contains no trace of oxide of chromium. Two samples in the collection of the Ecole des Mines have the same appearance. Analysis:—

Moisture,	0·67
Silica,	41·20
Oxide of lead,	49·05
Oxide of copper,	5·05
Alumina,	0·17
Oxide of iron,	0·05
Lime,	0·12
Potash,	3·96
Soda,	0·60

Seng-chang-kou-lou, green of the fifth quality, to a pound of which 5 oz. of *yuen-feng* are to be added (Ly).

The rough color is a mixture of fused vitreous fragments of two shades. Of these some are green, and resemble the green *seng-chang-lou*; the others yellow, and similar to the *chang-hoang*, which will be presently mentioned. The samples in M. Itier's collection and in that of the Ecole des Mines confirm this view of the composition of this color. By separating the fragments and weighing them separately, the authors found that the proportions were, of—

Chang-lou (green)	60
Chang-hoang (yellow)	40

The green fragments, analyzed separately, gave the same composition as the *chang-lou*:—

Humidity,	0·51
Silica,	41.50
Oxide of lead,	48·40
Oxide of copper,	5·50
Alumina,	0·40
Oxide of iron,	0·07
Lime,	0·18
Potash and soda,	3·44

The analysis of the separated yellow fragments gave 40 per cent. of silica; they were colored with antimony.

Eul-lou, second green (ticketed *vert jaune clair*).—This is a very fine powder, of a pale greenish-yellow color; on immersion in water, it is seen to consist of a mixture of green and yellow particles. It effervesces slightly with dilute nitric acid, the acid taking up lead.

Fen-lou, green powder (ticketed *vert jaunâtre clair*).—It is an intimate mixture of three different substances (green, yellow and white), which can only be distinguished well by immersing the powder in water. The color of the mixture is a pale yellowish green; it effervesces with dilute nitric acid, and the acid afterwards contains lead.

The analysis of these two greens gave the following results:—

	Eul-lou.	Fen-lou.
Loss by heat,	2.60	2·50
Silica with traces of stannic acid,	33·30	36·80
Oxide of lead,	53·14	51·04
Oxide of copper,	0·60	0·51
Oxide of antimony,	3·00	2·01
Alumina and oxide of iron,	1·06	1·12
Lime,	2·11	1·74
Magnesia,	0·03	0·05
Arsenic acid,		0·50
Alkalies and loss,	4·16	4·23

The authors remarked that there is a great uniformity in the composition of the flux in all these green colors; the following differs from them in this respect, but the difference is diminished by the addition of a large quantity of oxide of lead.

Seng-ti-lou, rough green of the sixth quality.—For use it must be pounded and mixed with *yuen-feng*, 19 oz. of the latter to a pound of color (Ly).

According to the catalogue of the Ecole des Mines, this green is pro-

cured from the district *Fou-leang-hien.* It is a very complex substance, formed of fragments of a sap green color, like *chang-lou*, and of a granular brownish powder with a tinge of violet. These substances are in the proportion of 75 parts of the green fragments to 25 of the powder. The green fragments present the reactions of the *Seng-chang-lou*; like it, they contain 41 per cent. of silica.

The brownish powder my be separated into three substances by washing in water:—

1. A green powder, which is certainly the result of the friction of the fragments of *chang-lou.*
2. A grayish sand-like powder, with the properties of *sy-chi-mo.*
3. A violet powder containing copper.

Nitric acid dissolves the brown powder with evolution of nitrous vapors, leaving the gray and green powders untouched. The solution contains copper. Dilute muriatic acid acts in the same manner, but when concentrated it also dissolves a little oxide of lead. Analysis:—

Silica,	67·9
Oxide of lead,	2·0
Copper,	20·7
Oxide of iron,	1·0
Lime,	0·3
Alumina,	0·5
Oxygen, potash, and loss,	7·6

The copper is here regarded as metal, as it exists in the substance in two states of oxidation. This composition fully accounts for the large addition of white lead indicated by Father Ly.

When triturated, this color forms a dull violet brown powder, but after baking it gives a bright green, similar to that furnished directly by the *chang-lou.*

In M. Itier's collection there is a similar color, which he calls Scheele's green.

Ta-lou, grass green (ticketed *vert de Scheele*).—It is a nankeen-colored powder, united into irregular fragments, and giving a green tint by the action of fire. It effervesces with dilute nitric acid, and the solution contains lead. Nitric acid does not attack it when heated; the nankeen color remains, which renders it probable that the copper is in the state of protoxide. Muriatic and nitro-muriatic acids attack it completely; a mixture of oxide of lead and deutoxide of copper is dissolved. Analysis:—

Loss by heat,	4·30
Silica,	35·20
Oxide of lead,	51·05
Oxide of copper,	3·98
Alumina and oxide of copper,	1·40
Lime,	1·00
Magnesia,	traces
Stannic acid,	traces
Alkali and loss,	3·07

All these greens consist therefore of a glassy flux, in which a few parts of oxide of copper are dissolved. The authors remark also that their direct experiments show that oxide of lead increases the greenness of the tint obtained from the oxide of copper. Soda produces a glass of which the tint is less blue than that obtained with an equal quantity of potash under similar circumstances.

5. *Yellows.*

The Chinese produce yellow on porcelain by means of antimony. There are, in the collections examined by the authors, several yellows, both in the rough and prepared state. They are called *thsing-hoang*, *chang-hoang*, *yan-hoang* and *hoang-se*.

The authors have analyzed the rough *chang-hoang* in the collection of Sevres, and the *hoang-se* brought by M. Itier. The authors offered so close a resemblance to these, that it was thought not worth while to analyze them.

Seng-chang-hoang, or yellow, to a pound of which 5 oz. of *yuen-feng* are added (Ly).—This is in bright yellow, fused, puffy fragments, with a slight greenish tinge. When reduced to powder, it is attacked by muriatic acid. Analysis:—

Humidity,	1·13
Silica,	40·47
Oxide of lead,	51·53
Oxide of copper,	0·35
Alumina and oxide of iron,	traces
Lime,	0·17
Antimonic acid,	3·60
Potash,	3·39
Soda,	0·71

Hoang-se yellow (ticketed *jaune*).—This is a pale yellow powder, which appears to be homogeneous even under water; it effervesces very slightly with dilute nitric acid, and the solution contains lead. The analysis shows that it is the same yellow as the *chang-hoang* of Father Ly, with the addition of a small quantity of the *yuen-feng*, which, he states, should be added to that color to render it fit for use. Analysis:—

Loss by heat,	2·10
Silica with traces of oxide of tin,	33·00
Oxide of lead	54·14
Oxide of copper,	0·30
Antimonic acid,	3·47
Alumina and oxide of iron,	0·80
Lime,	0·70
Magnesia,	0·60
Alkalies and loss,	5·09

All the Chinese yellows have therefore the same flux. To reproduce them, the following mixture must be slightly melted together:—

Orange minium,	8
Sand,	4
Antimony,	4

This gives a fusible Naples-yellow.

The following mixture is then thoroughly melted into a transparent glass:—

Orange minium,	44
Sand,	36
Fused carbonate of soda,	7

The two substances are then triturated together, and yellow will be obtained having the same composition and properties as the *chang-hoang*.

To be Continued.

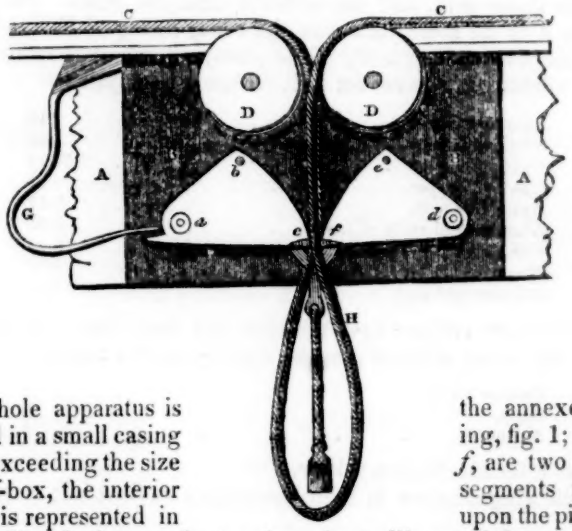
*Improved Support for Venetian Blinds.**

A model of a small apparatus recently patented by Mr. Brae, of Leeds, was exhibited. Its immediate destination is a self-retaining support for venetian blinds; in which the inconvenience daily endured by the present mode of fastening down the lifting cords by twisting them round a couple of hooks in the window frame, must be too present to every one's domestic experience to need description.

Contrivances for the purpose of self-supporting venetian blinds are, it is true, already in partial use; but they are subject to many objections, one only of which need be alluded to—so weighty, that of itself it recommends any improvement that may obviate it; this is the necessity for the blind being originally designed and manufactured for the express apparatus intended to be applied to it, thereby excluding from help the many thousands of existing blinds constructed upon the old principle.

A distinguishing advantage, therefore, possessed by the apparatus exhibited, is the facility it presents for being attached to any blind, old or new; but there is another peculiarity, which may or may not be considered an advantage, which is the option of placing the raising cords so as to hang down in the centre of the window, instead of at the side, and thereby removing the operation to a more convenient and accessible situation.

Fig. 1.



The whole apparatus is contained in a small casing scarcely exceeding the size of a snuff-box, the interior of which is represented in the annexed drawing, fig. 1; *a b c*, *d e f*, are two eccentric segments revolving upon the pivots, *a a*.

The radii, *a b*, *d e*, are shorter than the radii, *a c*, *d f*; consequently, when the segments are in the position represented in the drawing, their circumferential edges are nearly in contact; but when they are drawn down so as to cause the shorter radii to approach, a considerable space or opening will then exist between them. Each segment is provided with a similar segment of cogged teeth, only that these are not eccentric, but are portions of true circles, so that when together, the teeth of one

* From the Journal of the Society of Arts, London, No. 15.

working between those of the other, the two segments are always constrained to move simultaneously; for the sake of clearness, these cogged portions are omitted in the figure.

Two straps are seen beneath the segments uniting in one shorter strap, from which the middle tasseled cord depends. These straps pass up behind the segments, and pulling from the points *b* and *e* cause the segments to descend and increase the opening between them. Finally, the segments are impressed with a constant tendency to close upon any intervening substance by the action of the spring G.

D D are leading pulleys, over which the ends of double cord H are led in the usual way, down through the blades of the blind, so as to gather it up.

It will be apparent from this description, that when the double cord H is pulled downwards the segments will at once give way and admit of the blind being pulled up, but it cannot recede, because the tendency is then reversed, and the greater the pull the greater the resistance to it; therefore the blind remains at any altitude; and when it becomes desirable to lower it, the tasseled cord pulled, by which the segments are again reversed, the resistance to the descent removed, and the extent of the descent regulated by the principal cords in the usual way. The small box containing the apparatus may be so constructed as either to be screwed on to the exterior of the top rail of the blind, or it may, as in the model, be bodily let into its substance.

Mr. Brae believes that the principle shown in this little invention may be usefully applied in many other cases, and especially in certain of the numerous operations on board ship, in which the power of tightening and firmly holding a rope or cord is required.

Fig. 2.

Fig. 2 represents the construction of the segments of the detainer in its application to lowering boats from the davits, freeing life-buoys, and other purposes on board ship,—when, instead of a string for the back, and a spring to incline the longer radii to be opposed, a lever and counterpoise are used.—*Proc. Soc. Arts, London.*

Specification of a Patent granted to LAZARE FRANCOIS VAUDELIN, *for Improvements in obtaining Wool, Silk, and Cotton from old fabrics, in a condition to be again used.*—(Sealed 30th June, 1852.)*

The object of this invention is to obtain wool, silk, and cotton from old fabrics, in such a condition as to admit of the same being again spun and used in the manufacture of other fabrics; and it is proposed to

*From the London Journal of Arts and Sciences, March, 1853.

effect this by passing the old fabrics, whilst immersed in water, between a rotating cylinder and a flat plate, or other surface, armed with teeth or points, by which the fabric is torn to pieces, and the fibres brought into a suitable state to be again manufactured into fabrics. It has hitherto been the practice to tear old fabrics to pieces, for the above purpose, in a dry state; but the fibres are not so readily separated, and are more injured and broken than when working according to this invention, with the fabrics constantly immersed in water,—whereby, also, the fibres are thoroughly cleansed.

Fig.1.

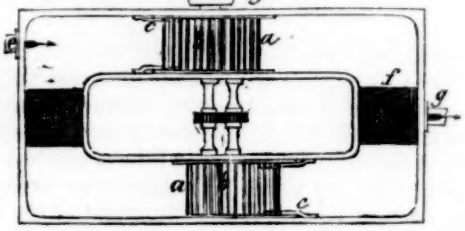
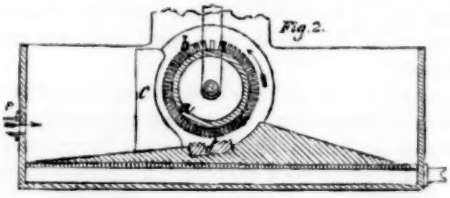


Fig.2.



The old fabrics having been washed, if they require it, are cut into pieces, say from two to eight inches square, and then introduced into a machine similar to those employed in the preparation of rags for making paper, except that the patentee prefers to construct it with two beating-wheels. This machine is shown in figs. 1 and 2—fig. 1, being a plan view, and fig. 2, a vertical section thereof. *a*,*a*, are the beaters or beating-wheels, in the periphery of which numerous straight metal blades *b*, with plain edges, are fixed, at equal distances apart, and parallel to the axis of the beater. In some cases, however, as when tearing silk, cotton, and mixed rags, the patentee uses blades with notched edges; and then he places behind each beating-wheel a comb or bar, with points to hook off the silk or cotton, so as to prevent any clogging of the machine. The beating-wheels are furnished with covers (not shown), to prevent the splashing over of the water; and guards *c*, are provided, to prevent the fibrous materials passing between the flanches of the beating-wheels and the sides of the machine. Beneath each wheel there is fixed a metal plate *d*, covered with points or teeth, which serve, with the blades *b*, of the rotating-beaters, to tear and separate the fibres of the rags that are drawn between them by the rotation of the beaters. Water constantly flows into the cistern of the machine through the pipe *e*, and continually passes off through the perforated surfaces *f*, and pipe *g*. When silk goods are being operated upon, the work goes on better if the water is used at a tempera-

ture of about 90° Fahr., and a small quantity of soft soap may be introduced into the water with advantage. The axes of the beating-wheels can be raised and lowered by means of screws (not shown), as may be required during the operation of separating the fibres.

The patentee states, that he does not confine himself to the above details, as the same may be varied, so long as the peculiar character of his invention—that of treating old fabrics in water, so as to separate the fibres into a state to be again used with other fibres in the manufacture of fabrics, by spinning and weaving—be retained.

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*Process for Electro-Plating China Ware.**

A specimen of china, coated with silver, was exhibited. Hitherto the art of electro-plating has been chiefly confined to metallic bodies, owing to their affinity for such deposits. The patent recently taken out by Mr. Ridgway, of the Staffordshire Potteries, extends it to Parian figures, ornamental china and glass, and to every description of Ceramic ware.

The advantages are manifold, when it is considered that this art may be applied to the most beautiful models, so as to retain all their sharpness and effect, without the cost of dies and other heavy charges to which the metallic department is subject, thereby cheapening the article; while, by means of chasing and embossing, richness is given.

The mode of effecting the electro-deposit is as follows:—In the first place, the articles are steeped in strong alcohol, or certain gelatinous solutions, and when nearly dry immersed in nitrate of silver or otherwise, so as to prepare them for receiving the deposit of copper. This done, they are plunged into cold water, and carefully dried in a suitable kiln, after which they are placed in sawdust for twenty-four hours to prevent oxidation.

The next operation is to remove any roughness on the surface which the articles may have contracted. This is done by means of sand paper or silver sand, and brushing with a scratch-brush till they are made perfectly smooth, care being taken to remove any greasy matter from the surface.

The copper and silver have now to form one alloy, so as to unite them firmly together. For this, a film of quicksilver is employed, dissolved in nitric acid. This is set aside to crystallize, and the crystals are dissolved to form the desired solution; the articles are then dipped therein, passed through water, and introduced into the vat containing the silver solution.

The silver solution consists of metallic silver dissolved in nitric acid diluted with water, with the addition of certain cyanides, till a given result is obtained. This is followed by a repetition of the copper process only with the solution, and the articles in due time appear in their silver garb, ready to receive the chasing.

Gold is prepared by being dissolved in nitro-muriatic acid. This chloride is digested with calcined magnesia, and the whole precipitated into an oxide. The oxide, boiled in strong nitric acid, dissolves the magnesia, and when washed forms a cyanide of gold and potassium.

* From the Journal of the Society of Arts, London, No. 15.

The films of gold are deposited in the vessels by means of voltaic electricity, a process requiring careful observation, both to insure an adequate coating and the proper color; if defective, it will have to be repeated.

The time of exposure to the heat depends upon its intensity, and the color desired to be produced; these must be the fruits of experience, and will not fail to be acquired by practice.

The finishing process is the burnishing, which is the same as with the silver, and requires no further illustration.

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*Manufacture of Lucifer Matches.**

The preparation of lucifer matches has been found to be productive of a painful disease in the workmen employed. The vapor evolved from the phosphorus acts upon the teeth and jaw-bones, in many cases producing caries; but a new species of phosphorus, called amorphous phosphorus, has lately been discovered. The nature of the chemical difference, if any, between this phosphorus and common phosphorus is not at all understood. The amorphous phosphorus is prepared by melting common phosphorus in a peculiarly-constructed retort, and keeping it for some time at a temperature of 500° Fah. By this treatment the phosphorus becomes a soft, opake mass, easily pulverized, and so incombustible, that it may be handled, or even swallowed, with impunity. This species of phosphorus is found to be suitable for matches, and does not give out injurious fumes. We extract the following from Tomlinson's *Cyclopædia of Useful Arts*:—

"The wood employed in the manufacture of lucifers is the best pine plank, as free from knots as it can be procured. Each plank is cut across the fibres, by means of a circular saw, into 28 or 30 blocks, each measuring 11 inches long, 4½ wide, and 3 inches thick. These blocks are cut up into splints by a machine of simple but ingenious construction, which we will endeavor to explain in a few words. To the extremity of the horizontal arm of a crank is attached a frame, which reciprocates to and fro with the motion of the crank through a space of about 4 inches. In this frame are fixed in a line some 30 or 40 lancets with the points projecting upwards, and separated from each other by pieces of brass. The block of wood to be cut is inserted by the small end between uprights, and a lever placed upon it forces it down to a position such, that, as the lancet-points advance, the end of the wooden block is scored or cut in the direction of or parallel with the fibres, with as many lines as there are lancets. As the lancets are withdrawn by the motion of the crank, a scythe blade moving in a horizontal plane swings round, and cuts off the end of the block to the depth of the scores made by the lancets. The pieces thus cut off will evidently be four-sided splints, square in section, supposing, as is the case, that the lancets are equidistant, and that the horizontal knife cuts exactly to the depth of the lancet scores. When the horizontal knife swings back, the block from which one layer of splints has thus been removed descends through a space equal to the depth of

* From the London Artizan for February, 1853.

the section, the lancet-points again advance and recede, and the knife again does its work. In this way the cutting is carried on with such rapidity, that from 12 to 16 planks, each 12 feet long, 11 inches wide, and 3 inches thick, can be cut up into splints in a day of ten hours. Now, supposing 14 planks are thus cut up, and that each plank produces 30 blocks, we thus get $14 \times 30 = 420$ blocks. Each block affords about 100 slices, which are cut off by the horizontal knife; but as each slice, before being cut off, has been scored by 31 lancet-points, we thus get $420 \times 100 \times 31 = 1{,}302{,}000$ splints; and as each splint makes two matches, we thus have 2,604,000 single match-splints per day.

Fig. 1.

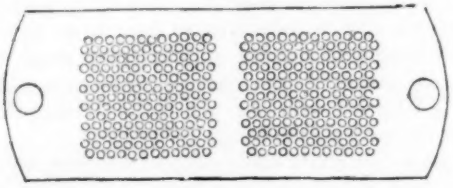


Fig. 2.

"When a circular, instead of a square section is required, the wood is cut into splints by means of a perforated metal plate, the perforations being so shaped as to cause the block of wood, when pressed against its face, to be properly divided. Fig. 1 shows the face of the plate, and fig. 2 a vertical section of the same. The perforations are cylindrical throughout, except at their openings on the face, where they are slightly countersunk, for the purpose of presenting sharp-cutting edges to the wood, and affording a more easy entrance. The perforations are made as close together as possible, that all the wood may be used, only sufficient metal being left to afford the necessary strength for cutting. The plate has a steel face and a bell-metal back; it is 3 inches wide, 6 inches long, and about 1 inch thick. The back is fixed against a firm resisting block or bearing, with an aperture equal to the area of the perforations of the plate. The piece of wood being placed on end in the direction of the fibres, the plate is forced down upon it by means of a plunger or lever, when the splints appear at the back of the plate, whence they are removed before another block is applied. This plan was patented by Mr. Partridge in 1842.

We now return to the square match. As the splints fall off the end of the block by the action of the horizontal knife, they pass down a shoot immediately under the block into a room below, where they are tied up into bundles, each containing half a gross. For this purpose, a cradle or measure is formed, consisting of a section of a hollow cylinder, of the capacity of half a gross of splints of the proper size, either for the *large* splints, or the second size, called *minikins*, these being the only two sizes made at this factory. The man begins by throwing a piece of string

across the cradle, then taking up a number of splints from the confused heap, he ranges them in parallel order by a dexterous system of tossing, knocking, and jerking. Having filled his measure, he catches the two ends of the string, ties up the bundle, throws it aside, and then proceeds to make another, the work being done with the rapidity and precision which practice alone can give. These bundles are piled up on the racks of a hot-room or drying stove, and left for some hours, until moisture is expelled.

"The next process is the *sulphuring*. The sulphur is melted in an iron pot over a stove, and, when sufficiently fluid, the two ends of the bundles are successively dipped, the bundle being shaken after each dipping, in order to get rid of superfluous sulphur. When the sulphur is dry, a second string is tied round each bundle, so that, when divided by the circular saw, each bundle of double matches may make two bundles of single matches. Some of the matches, however, are not divided until after having been tipped with the phosphorus composition; but this is merely a matter of convenience to the makers.

"The matches are now ready for dipping in the phosphorus composition. We are not informed as to the precise ingredients of the composition, or the method of mixing. Each manufacturer professes to have his own recipe, which he regards as the best, and therefore keeps secret. The ingredients are, however, well known to chemists; the principal one is phosphorus, which is made into an emulsion with glue or gum arabic, the former being preferable, since gum absorbs moisture. Some makers use nitre, others fine sand; and all use coloring matter, which may be red ochre, red lead, smalt, or artificial ultramarine.

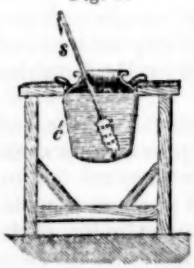
"The following proportions have been found to answer:—

	Glue paste.	Gum paste.
Phosphorus,	2·5	2·5
Glue,	2	Gum 2·5
Water,	4·5	3
Fine sand,	2	2
Red ochre,	0·5	0·5
Vermillion,	0·1	0·1

"Instead of the last two coloring substances, 0·05 of Prussian blue may be used.

"When glue is used, it is of very inferior quality. It is broken into fragments, and soaked for a few hours in cold water; then dissolved in a large glue-pot, or copper, heated by a water bath. When it is perfectly fluid, and at the temperature of 212°, the copper is withdrawn, and placed in the circular opening of the frame (fig. 3). The phosphorus is then added by degrees; it melts immediately, and subsides, but is kept in agitation by means of the wooden stirrer, *s*, which is furnished at the lower part with projecting pegs, the object being, as the glue cools, to obtain an emulsion of phosphorus in a minutely divided state. The sand and coloring matters are added during the stirring. The paste is kept at the temperature of about 98°, sufficient to retain it in a fluid state by placing the vessel, c, in a water bath."

Fig. 3.



FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, July 21, 1853.

John E. Addicks, Esq., President, P. T., in the chair.

Edmund Draper, Esq., Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

A letter was read from Dr. C. M. Wetherill, accompanying his donation of Specimens of Iron and Iron Ores of the State of Pennsylvania.

Donations to the Library were received from The Statistical Society and The Society of Arts, London; The Smithsonian Institution, Washington, D. C.; The Maryland Institute, Baltimore, Md.; Wm. J. Lewis, Esq., California; A. J. Brasier, Esq., and Prof. John F. Frazer, Philadelphia; and the Medical Superintendents of American Institutes for the Insane.

Donations to the Cabinets—From Dr. Charles M. Wetherill, a Collection of Iron and Iron Ores of the State of Pennsylvania, consisting of upwards of 500 specimens, arranged and catalogued.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement for June was read.

The Board of Managers and Standing Committees reported their minutes.

The Chairman of the Committee on Exhibitions made a verbal report of their proceedings.

New candidates for membership in the Institute (4) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

On motion, a special vote of thanks was presented to Dr. C. M. Wetherill, for his valuable donation of Specimens of Iron and Iron Ores.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on P. N. Receveur's Improved Rose Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improved Rose Engine," invented by Mr. P. N. Receveur, of Philadelphia, Pennsylvania—REPORT:

That the improvements alluded to are numerous and important, and require description in detail, as follows:

In the engine employed for rose turning the following kinds of movement are required:

1st, Revolution of the work for oval and circular cutting, with its modifications; or a reciprocating movement for right line or parallel cutting, with its modifications.

2d, Lateral motion of the work or tool, to produce the wavy lines of a pattern.

3d, End motion of the work towards or from the tool, to change the depth of cut at stated and regular distances.

4th, A change (at will) of the connexion between the work and the pattern, so that the angle between the two can be varied at any moment.

5th, A feed motion to carry the tool in a lateral direction given distances at stated periods required in producing a series of parallel or concentric cuttings.

6th, A circular motion of the tool on its bed or rest, so as to vary the angle of the cut required in engraving the edges of watch cases, &c.

The general form of the machine embodying the foregoing movements, and called the *rose engine*, may be briefly described as consisting of a hollow mandrel, on which are several narrow drums, whose peripheries are scolloped or shaped according to different designs; passing through this mandrel is another, solid, revolving in bearings or journals, and carrying in the front end chucks, &c., as in the ordinary lathe, and a cord wheel at the other end, through which rotating movement is communicated in the usual way. The hollow and solid mandrels may be connected or disengaged at will, by a pawl pressed by a spring into notches cut at regular intervals into the circumference of a plate at the back end of the guide drums. The tool is attached to a frame, which, in Mr. Receveur's improved engine, is pivoted on the table, and is free to vibrate laterally: its motion in this direction is governed by a point bearing against the guide drums; and which being fixed opposite either of these, of course moves the tool in accordance with the pattern cut upon its edge; or when withheld from contact by lightening a spring, the tool describes either a circular, oval, or straight vertical line, as the case may be.

The solid mandrel carrying the work is at liberty to move endwise, for the purpose of deepening or lightening the cut, the tool having no such motion; the shaft is pressed against a shoulder by a spring, and is reacted against this spring by a point attached to the tool frame bearing upon wavy surfaces cut on each alternate guide drum projecting from the others for the purpose. It is clear that the pattern on such guide drum will regulate the depth of the cut. The vertical motion for right line work is produced by an eccentric, and a pentagraph lever movement connected with the same eccentric enables any given pattern to be reduced in any ratio upon the work, giving rise to endless variety in the designs.

The important points of difference between the old machine and that of Mr. Receveur, are, first, that the tool frame is in his engine made movable, and the mandrel, with the work, rotates in permanent bearings; while in the old machine this condition of things is reversed, so that while in this latter the momentum of the moving parts vibrating is such as to preclude a great rapidity of motion, preserving the necessary uniformity and delicacy of cut, in the engine of Mr. Receveur, by a very simple but ingenious modification, the speed at which work can be done is limited only by the skill of the operator. 2d, That in the old engine, in order to change the angle between the work and pattern, it is necessary to stop the rotation of the mandrel, while the pawl before described as connecting the two is released, and after moving the drums to the desired point, again notched; while in Mr. Receveur's engine, a pedal arrangement is intro-

duced, whereby the aforesaid pawl is tripped by pressure of the foot; the point on the tool frame is at the same time advanced, so as to press tightly against the drums, and so keep them from turning, while the operator continues the rotation of the mandrel until it has arrived at the desired point, when the pawl is again pemitted to drop in. It should be observed that this cannot be applied to the old form of engine, on account of the vibrating pedestals supporting the drums, and the fixed tool frame, &c., which of course renders it impossible to hold the drums while rotation of the mandel is carried on. This again permits of much greater rapidity in the performance of work.

3d, In the old engine the weight of parts in the pentagraph lever arrangement is balanced by a weight suspended by a cord passing over pulleys; while in the new engine, they are connected to a spiral spring, like the main spring of a watch, placed beneath the table, and so arranged that equilibrium exists at any point in the vertical stroke. As the delicacy of the cut in right line work would be destroyed by any irregularity of motion, this must be looked upon as a decided improvement.

Besides these principal points, there are numerous details of minor importance, but all tending to facilitate the execution of designs, which it is impossible to describe in the limits of a paper like this, and which, though perhaps they are movements already known separately in the arts, are believed to have been first applied by Mr. R. to the rose engine.

The Committee feel satisfied, after a close examination of Mr. Receveur's improved engine, that the features he has introduced are highly ingenious, and promote in a marked degree the objects desired, viz: rapidity, accuracy, and variety of design; while they are believed to be original, and applied first by him to the purpose.

They therefore recommend that a Scott Legacy Medal and Premium be awarded to him for his invention.

By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, June, 9th, 1853.

Report on Mr. Jacob Senneff's Metallic Heddles.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Metallic Heddles," invented by Mr. Jacob Senneff, of Philadelphia, Pennsylvania—REPORT:

That they have given attention to Mr. Senneff's patent metallic eye harness for weaving, submitted to them for examination, and find it is made by casting soft metal nearly cylindrical in the middle and pointed at each end for the thread, with an oblong eye in the centre, through which the warp is drawn. The twine or thread is otherwise arranged as in the ordinary harness. The form of the eye, and its peculiar smoothness, afford great facilities in weaving, and at the same time presents less obstructions in passing through the warp whilst operating.

The most approved kind now in use are made of twine exclusively;